

User's Manual

nac

MOVIAS Pro

SP-613

(Ver. 1. 63)

NAC Image Technology Co., Ltd.

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MOVIAS Pro User's Manual

March 200

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1. About Movias Pro

1.1 Movias Pro

MOVIAS Pro is software designed for motion analysis.

It uses a high speed camera to photograph automobile crash safety tests, cell phone drop tests and the physical movements of athletes. The movement of the target marks from the photographed graphic image file affixed to each part of the subject are automatically tracked. The tracked movement can be displayed as line drawings, graphs or numerals of the analytical results. An example of the analytical results is shown in Figure 1.

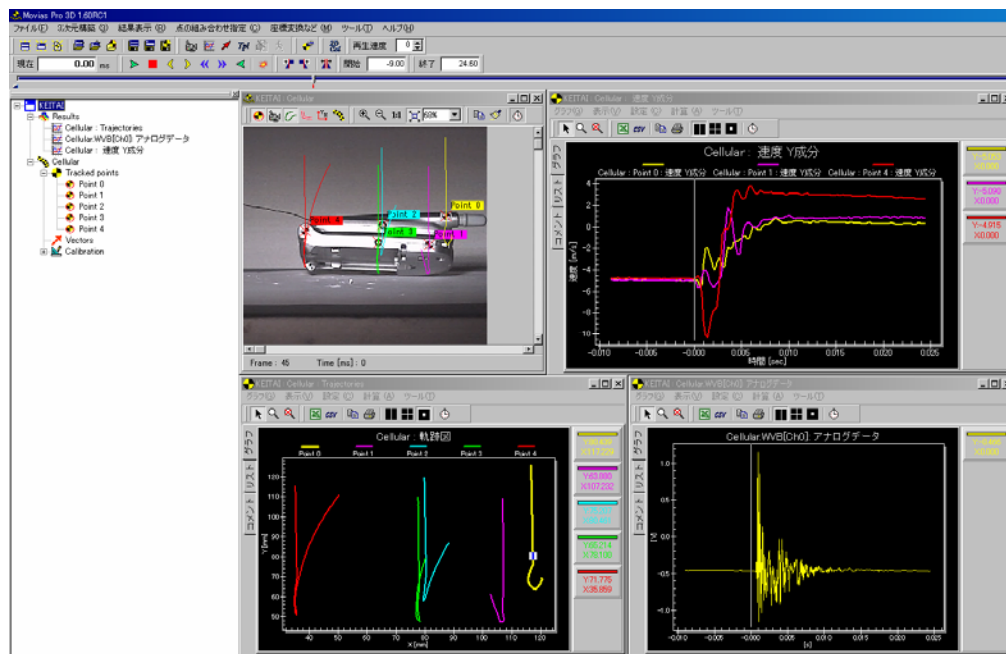


Figure 1 Example of Analytical Results

This shows an analysis example of the status with cell phone drop tests, with the following details.

- Top left screen : Image with tracked results labeled
- Top right screen: Graph of the Y direction velocity for each tracked point
- Bottom left screen: Graph of the trajectory for each tracked point
- Bottom right screen: Graph of the imported acceleration sensor signals¹

¹ This function to import electrical signals such as acceleration sensors is an option.

There is a two-dimensional version and a three-dimensional version of Movias Pro. The three-dimensional version includes all of the functions included in the two-dimensional version.

With the three-dimensional version, objects for analysis are photographed from a multitude of differing directions and two-dimensional data is extracted from each image. Three-dimensional data is created by combining this data with calibration chart information in order to perform an analysis. With the two-dimensional version, analysis is conducted only using images from one direction.

In general, tracking of target marks in the images that become the base for analysis is automatically conducted but even if performed manually, it is possible to manually correct the results of automatic tracking. The images in the video file (AVI file) displayed on the PC screen are automatically tracked.

The results are displayed as a numerical list, graph or line drawing. Some of the results (such as trajectories or stick figures) can be displayed superimposed on the images.

Wave data² such as acceleration sensor signals and electromyograph signals are imported and these can be simultaneously played back with the image or graph. Data can be directly exported to Excel and data can be exported to other software programs via a text file such as ASCII.

² Binary .WVB files created with the image-wave synchronous display software Wave-in produced by Library Corporation and text files with a CSV format for Movias Pro can be imported.

1.2 Recommended Operating Environment

Movias Pro can be operated on PCs with the following specifications.

CPU : Intel Pentium3, 500MHz or equivalent
(Pentium 4 2GHz or higher recommended)
Memory: 256MB or greater (512MB or greater recommended)
Hard Drive: at least 500MB of free space (2GB or greater recommended)
Display: Resolution 1024x768 or greater (1280x1024 or greater recommended)
24 bit color display (required)
OS: Windows XP (SP1 or later recommended) , Windows 2000 (SP4 or later recommended)
Other: CD-ROM drive for software installation required.
1 USB port or 1 parallel port required for security key.
Software: Microsoft Excel³ required for use of the Excel output function.
Adobe® Reader® (<http://www.adobe.co.jp/>) installation necessary for viewing supplemental manual and sample files.

³ Our version is for Excel 2003 (Windows XP SP2) and Excel 2000 (Windows 2000 SP4) and is not guaranteed to function with all environments.

Installation

1.2.1 Movias Pro Installation

Start “SetUp.exe” on the CD from Explorer to install Movias Pro.
(Administrative rights are required for installation so have the user with such rights log on before starting)

Once SetUp.exe is started, the “Welcome” dialogue box from Figure 2 will be displayed.



Figure 2 Welcome dialogue box

Click “Next” to proceed to the “Authorized Use” dialogue box in Figure 3.

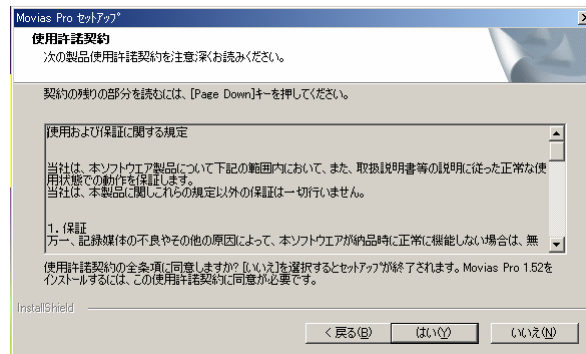


Figure 3 Authorized Use dialogue box

Carefully read the “Warranty and Conditions for Use” displayed and click “Yes” to agree and proceed to the “User Information” dialogue box in Figure 4. Click “No” if not in agreement to interrupt the installation process.

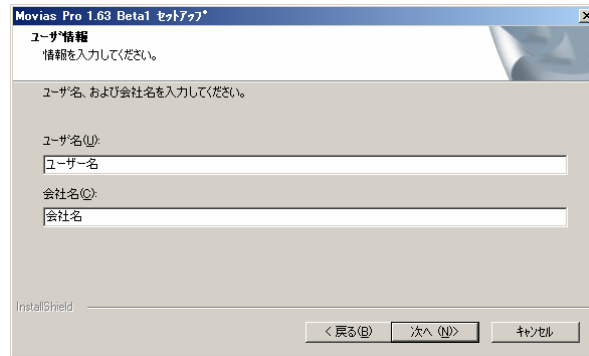


Figure 4 User Information dialogue box

Input the user name and company name in the “User Information” dialogue box. Both items are required. Once input is complete, click “Next” to proceed to the “Select Before Installing” dialogue box in Figure 5.

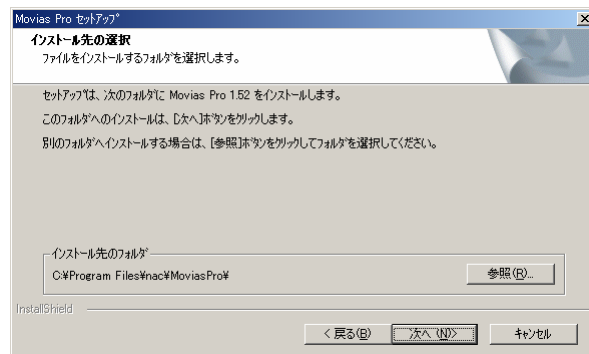


Figure 5 Select Before Installing dialogue box

Designate the folder for installing Movias Pro in the “Select Before Installing” dialogue box and then click “Next”. The “Start Copying Files” dialogue box in Figure 6 will appear.

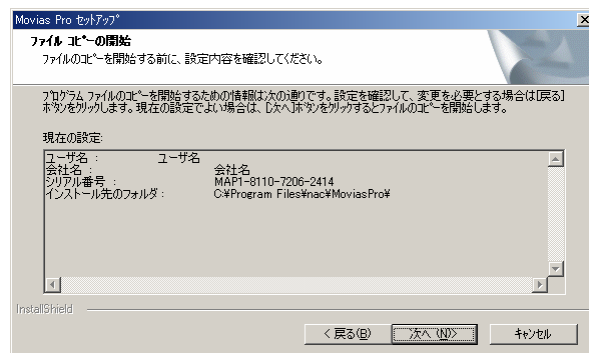


Figure 6 Start Copying Files dialogue box

Details of current settings will be displayed in this “Start Copying Files” dialogue box. Verify details and if there are no problems, click “Next” to start copying the files. If errors are found in the settings, click “Back” to correct the settings.

After copying the files, the “Installing Security Key Driver” dialogue box in Figure 7 will appear.

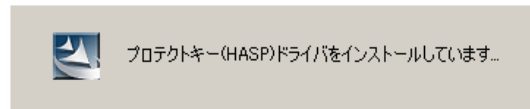


Figure 7 Installing Security Key Driver

Once installation is complete, the “Movias Pro Installation Completed” dialogue box in Figure 8 will appear. Click “Finish” to end the operation.

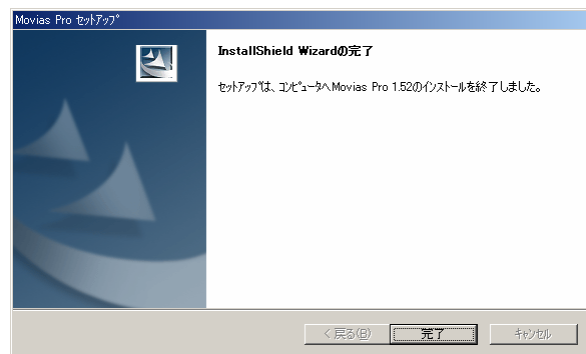


Figure 8 Movias Pro Installation Completed dialogue box

1.2.2 Remove Movias Pro

Use “Add or Remove Applications” on the control panel to remove Movias Pro from the system. Click on “Movias Pro” to select and remove. The “Confirm File Removal” dialogue box in Figure 9 will appear.

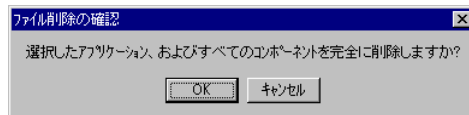


Figure 9 Confirm File Removal dialogue box

Click “OK” to completely remove Movias Pro. Click “Cancel” to cancel removal.

1.3 HASP Security Key

A HASP security key is used to protect programs in Movias Pro. If the HASP security key is not properly inserted into the PC, Movias Pro will not function.⁴

There are two types of HASP security keys. The functions for the parallel port model (Figure 10) and the USB port model (Figure 11) are identical.



Figure 10 Parallel Port Model

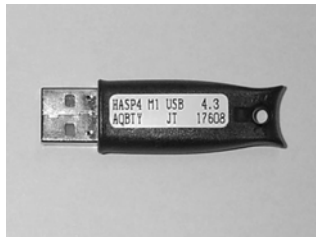


Figure 11 USB Port Model

⁴ The HASP security key is not required for installation of Movias Pro. The HASP security key is required for operation.

1.4 Movias Pro Startup

1.4.1 Movias Pro Startup

Start Movias Pro by clicking the icon on the desktop. Or start by clicking on “Movias Pro ***” on the “Movias Pro ***” menu (***) is the version) in Start Programs of Windows.

1.4.2 Warning Messages when Starting Movias Pro

1) If the HASP Security Key is Not Inserted

If the HASP security key is not inserted or has loosened, it will await insertion of the HASP security key and then will display the “HASP Error” screen shown in Figure 12. In this case, after verifying insertion of the HASP security key, restart Movias Pro.



Figure 12 HASP Error

If this error is displayed even when the HASP security key is properly inserted, either the driver is not installed correctly or the key itself may be defective. Please contact us.

1.4.3 Other

1) Screen Savers

Turn OFF the Windows screen savers. In particular, if a screen saver starts when processing automatic tracking, the speed of the operation will decline and problems caused by the screen saver may occur.

2) Windows Design and Performance

If using Movias Pro on WindowsXP ServicePack2, either set the WindowsXP visual effects to “Prioritize Performance” or uncheck “Use Visual Style for Windows and Buttons”. (Refer to Figure 13)

Otherwise, the Movias Pro tracking speed will decline. This can be set with Control Panel→System→Setting Details→Performance.

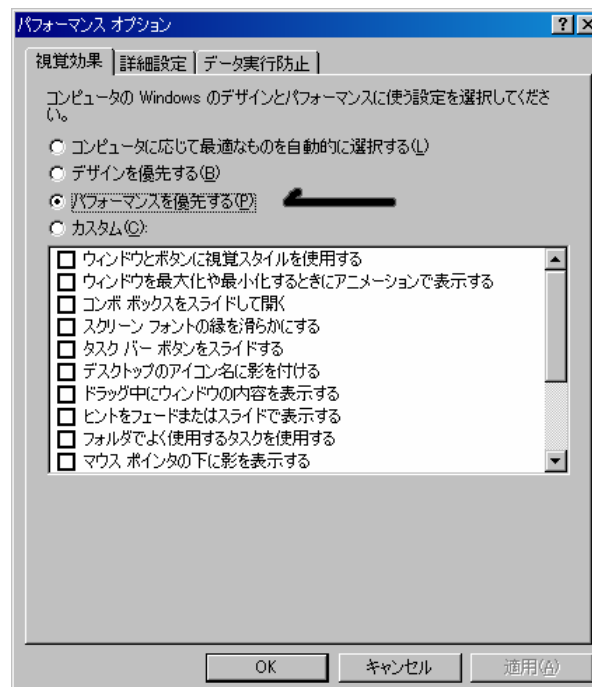


Figure 13 WindowsXP Visual Effects

1.5 User's Manual and Sample Marks in pdf Files

There is an item called "User's Manual" in the "Movias Pro ***" (***) denotes the version) menu in Windows Start Programs. Click on this item to open the User's Manual (this document) converted to a pdf file⁵. pdf files are copied into \doc folders of folders where Movias Pro has been installed. Distribute to those who use Movias Pro.

Additionally, there is an item called "Sample Marks" in the "Movias Pro ***" (***) is the version) menu in Windows Start Programs. Click on this item to open the pdf file containing the target mark samples. Print this and use by affixing the mark of the appropriate size to the target for analysis (subject) with two-sided tape. pdf files are copied into \doc folders of folders where Movias Pro has been installed.

⁵ Adobe's Adobe® Reader® is needed to open pdf files.

2. Motion Analysis Tutorial

Try motion analysis using a sample video before starting the detailed description of Movias Pro.

There is a folder named “Sample” in the folder where Movias Pro is installed, containing sample AVI files of cell phone drop tests. In this tutorial, use the sample AVI file for a description of the series of steps for automatic tracking of target marks. ⁶

The target marks used for tracking are shown as the 5 points in Figure 14 ⁷ from Point 0 to Point 4. Three points are 4-quarter marks and two points are solid marks. CAL 1 and CAL 2 (jointly used with Point 4 and Point 1) are used for calibration (standard length) where the space between these two points is 72mm.

⁶ This tutorial describes the process for secondary analysis. The process for automatic tracking target marks for tertiary analysis is identical.

⁷ Calibration described in this tutorial is for secondary analysis. Calibration for tertiary analysis is completely different.

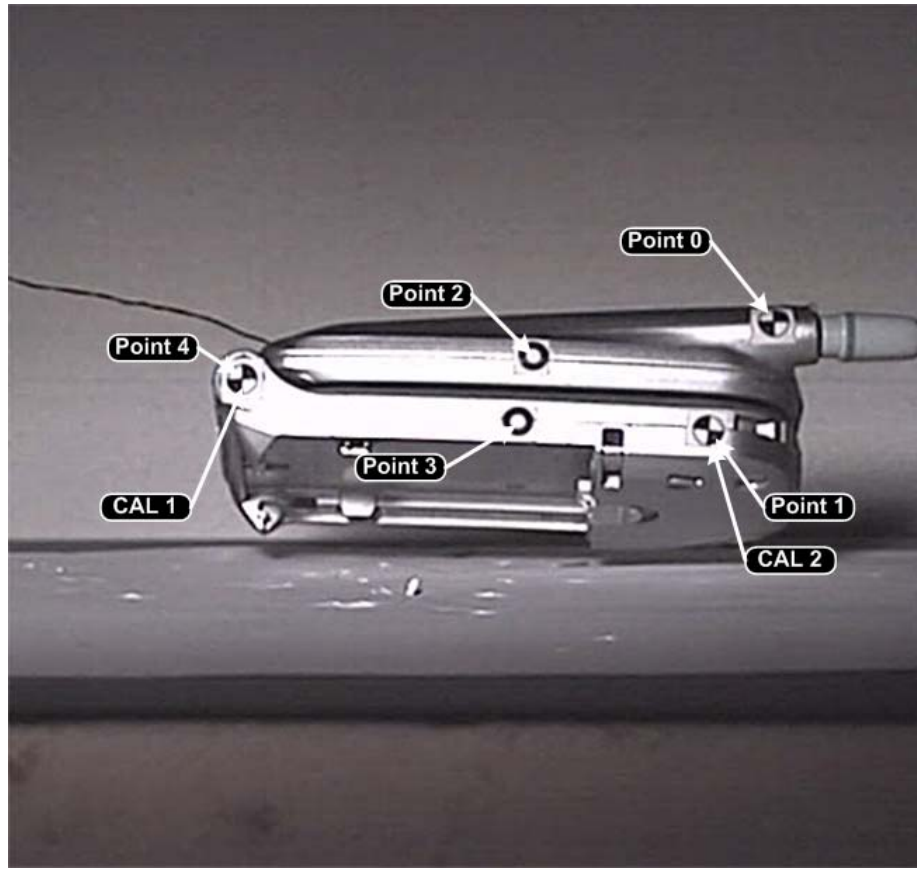



Figure 14 Diagram of Target Marks and Calibration

1) Startup

Double click on the desktop icon  to start Movias Pro.

2) Creating Projects

First, click on new project in the file menu to create a project. ⁸ (Figure 15) Designate a project name. The project name for this tutorial is KEITAI since it analyzes the results of cell phone drop tests.

(Before conducting this the first time, it is necessary to conduct the following エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。)

⁸ Creating a new project is conducted first in Movias Pro. Analysis of multiple AVI files can be performed in one project.

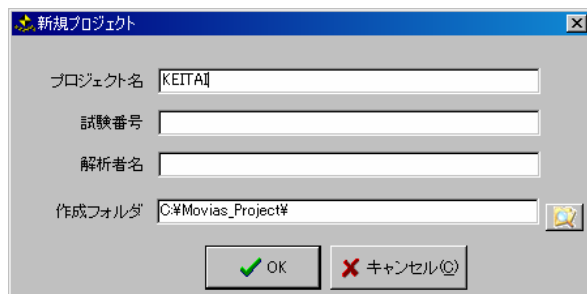


Figure 15 New Project

Image data for analysis and analysis results are saved in projects.
For details, refer to “3.2 Projects and Sequences (→page 43) .

3) Designating Initial Project Storage Folder

Initially, the confirmation message in(Figure 16) is displayed so click “Yes” to set.⁹

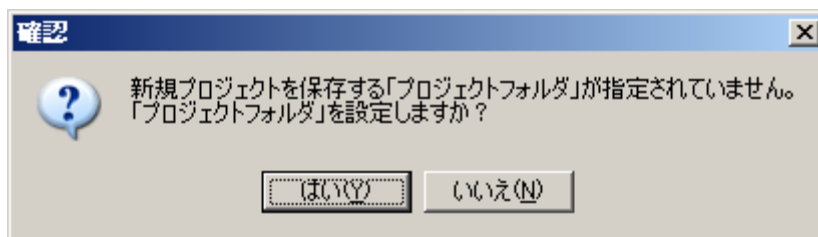


Figure 16 Verifying Project Folder

Next, the following Figure 17 is displayed so the new project settings are saved in the “Project Folder”. (The default is in the “Movias Projects” folder under “My Documents”.)

⁹ If there are settings that were previously used, such as with an upgrade, the default settings are carried over and this screen is not displayed.

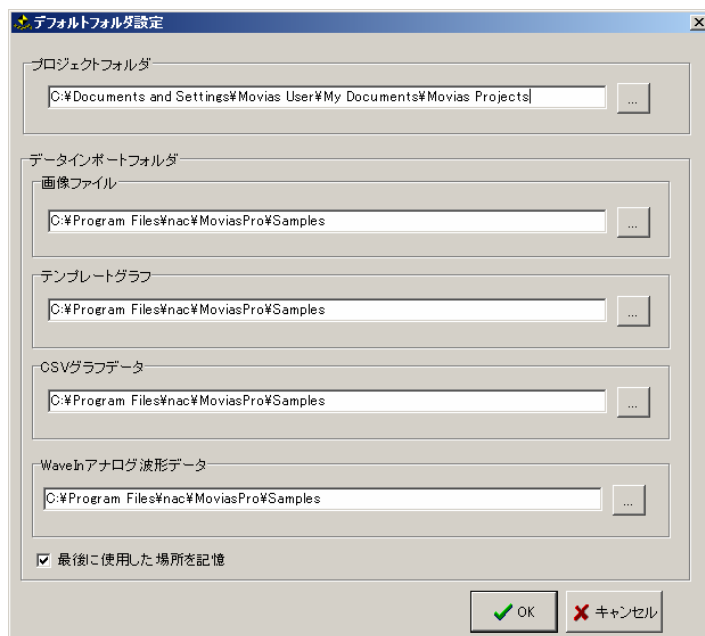


Figure 17 Project Folder Settings

These settings can be reset from “エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。(→page エラー! ブックマークが定義されていません。)”.

4) Creating a Sequence and Opening an Image File

Once a project is created, the Create New Sequence screen in Figure 18.¹⁰ Here, an AVI file is designated to name the sequence and perform analysis. The AVI file used in this tutorial is Cellular.avi in the sample folder. (if installed with the standard settings, it is C:\Program Files\nac\Movias\Samples\Cellular.avi.¹¹)

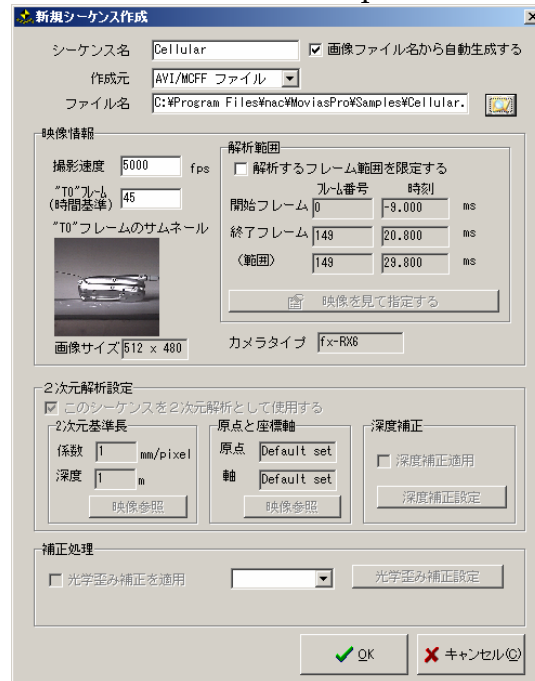


Figure 18 Create New Sequence

Since “Automatically Create from Image File Name” is checked, it is ON so when specifying an image file, the sequence name “Cellular” is identical to the image file name. Create a sequence name if necessary.

After specifying the image file and inputting the sequence name, click “OK”.

¹⁰ In Movias Pro, sequences are created in projects where analysis such as graph creation can be performed by tracking target marks in an AVI file. Multiple sequences can be created in a single project.

Subsequently, new sequences can be created in the File-New-Sequence menu. The new sequence screen (Figure 18) is automatically displayed immediately after new project creation.

¹¹ At this point, the photographic speed cannot be set. The photographic speed is automatically set to analyze AVI files created by our high-speed video cameras and camera software. In this example, there is a text file Cellular.avi.txt that stores information such as photographic speed, along with the AVI file Cellular.avi. Movias Pro automatically sets the photographic speed with the information in this text file. In this example, this function properly sets the photographic speed at 5000fps.

When a new sequence is created, the tracking window (Figure 19) that performs automatic tracking is displayed.

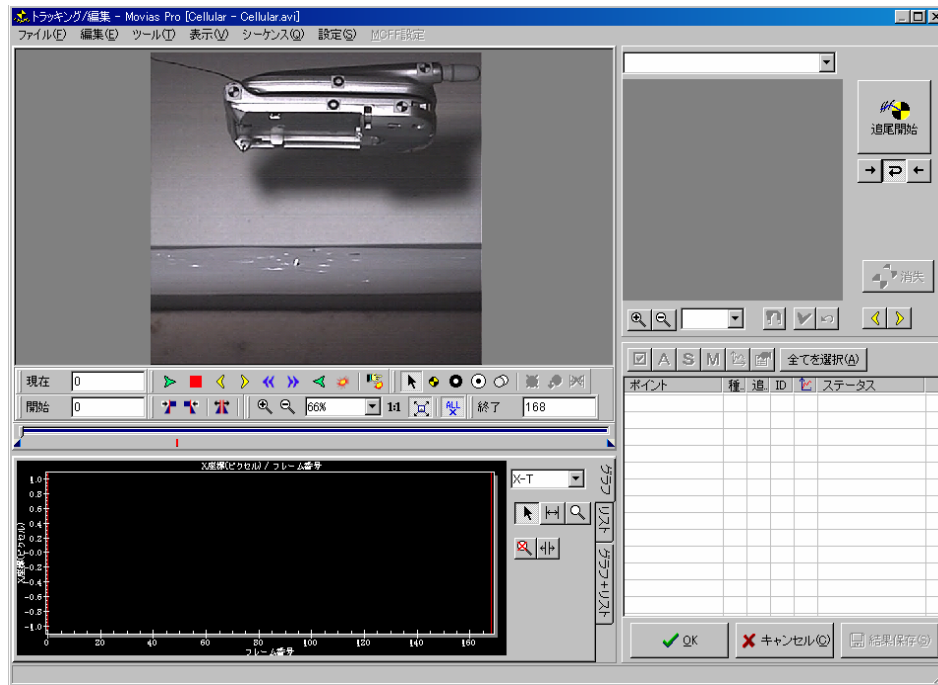


Figure 19 Tracking Window

5) Specifying Tracking Points and Adjusting Tracking Parameters

First, specify the tracking points. In this example, the five targets ultimately shown in Figure 14 are tracked. To simplify this explanation, Point 0 and Point 1 are tracked. These two targets are 4-quarter targets so first click the 4-quarter Add Target button (Figure 20) for the 4-quarter Add Target mode.



Figure 20 Add 4-quarter Target Button

Next, click in the vicinity of the center of the first point in Video View. (Figure 21) ¹²



Figure 21 Click on the Center of Point 0

¹² Zoom View shows a magnified display of the area clicked.

Zoom View shows a magnified display of the area clicked. (Figure 22)

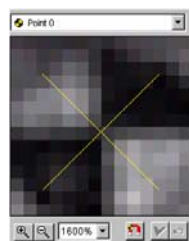


Figure 22 Point 0 Search Results

If the X symbol shown in the search results for the center position of the target is not centered with the target, click on target center in Zoom View, or correct by dragging the X symbol to the target center in Video View and clicking on the Confirm button.

For Point 1, click on the center (refer to Figure 21) and adjust the search results for the center as necessary (refer to Figure 22).

6) Start Tracking

Click the “Start Tracking” button to start tracking. Figure 23 shows screens during tracking and immediately after tracking is complete. In Graph View, a graph shows the tracking results.

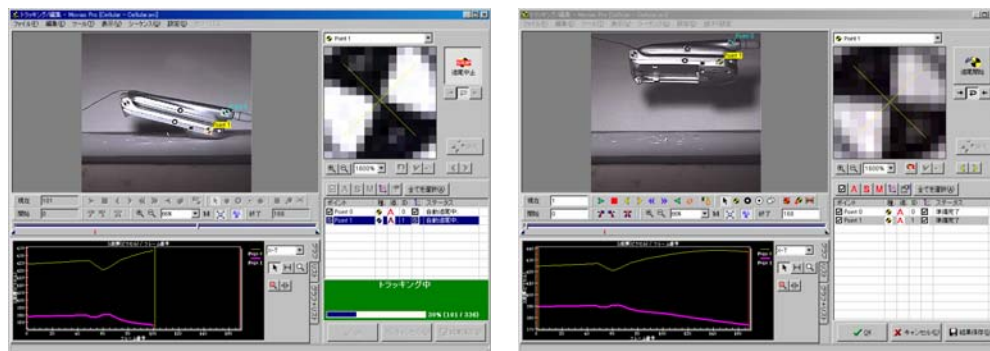


Figure 23 Screens During Tracking and Immediately After Tracking is Complete

7) Tracking of Point 2, Point 3 and Point 4 “Adjusting Tracking Parameters”

Next, continue by tracking Point 2, Point 3 and Point 4.

First, since Point 2 is a solid symbol, click on the Add Solid Symbol button before clicking on the center of the target (Figure 24) for the Add Solid Symbol mode.



Figure 24 Add Solid Target Button

Next, click in the vicinity of the center of Point 2 in Video View.(Figure 25)

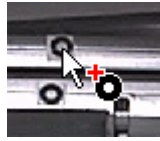


Figure 25 Click on the Center of Point 2

Zoom View shows a magnified display of the area clicked. (Figure 26)

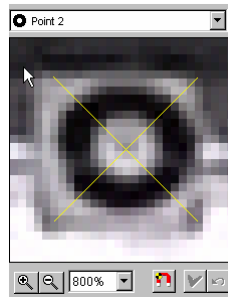


Figure 26 Point 2 Search Results

If the X symbol shown in the search results for the center position of the target is not centered with the target, click on target center in Zoom View, or adjust by dragging the X symbol to the target center and clicking on the Confirm button.



Click on the Point Properties button (Figure 27).



Figure 27 Point Properties button

Click on the “Detailed Settings for Tracking Parameters” button on the Point Properties screen (Figure 28)¹³.

¹³ Movias Pro automatically identifies the target marks and uses several tracking parameters during tracking. If these tracking parameters are not set for the size or photographic style of the target marks, it will be a factor in the failure of automatic tracking.



Figure 28 Point Properties Screen

The parameters are modified by accessing the Detailed Settings for Tracking Parameters screen (Figure 29).

- Make the template size 10x10. (formerly 18x18)
(cannot be modified any other way)

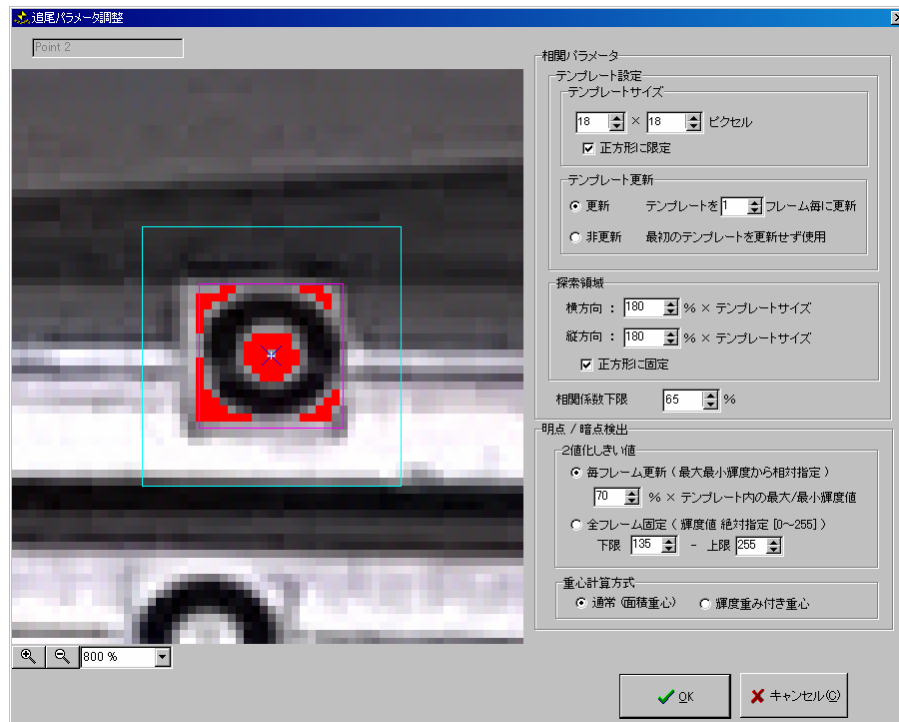


Figure 29 Screen before Tracking Parameters Details are Set for Point 2

Figure 30 shows the screen after parameter modification.

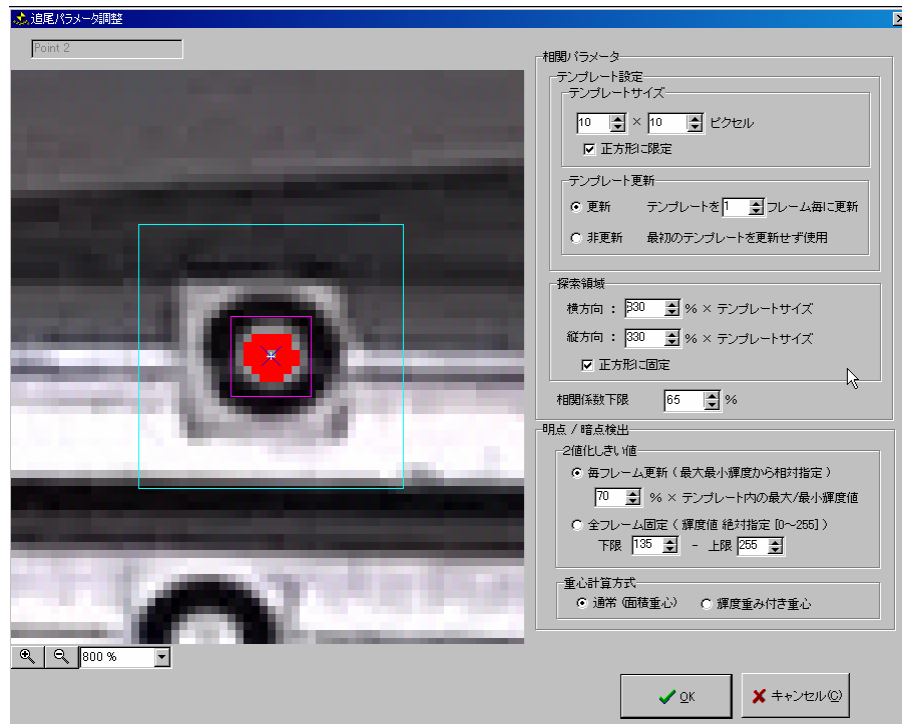


Figure 30 Screen after Tracking Parameter Details are Set for Point 2

Click “OK” after modifying.

The screen in Figure 31 will appear next. After clicking on “Save as Default after Applying”¹⁴, click “Apply”.

¹⁴ When clicking on “Save as Default after Applying” and then clicking on “Apply”, the tracking parameters after modifications are applied to the current tracking point for Point 2, and the solid targets in the future are applied as defaults. However, with multiple targets that are the same type, size and photographic style, if the point of the first tracked parameter is adjusted to be the default, there is no need to change subsequent points. If “Save as Default after Applying” is clicked, only one target mark can be adjusted for tracking parameters.



Figure 31 Point Properties Screen

Next, click in the vicinity of Point 3 in Video View. (Figure 32)

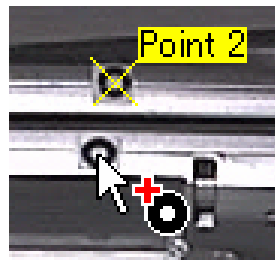



Figure 32 Click on the Center of Point 3

Zoom View shows a magnified display of the area clicked.

If the X symbol shown in the search results for the center position of the target is not centered with the target, click on target center in Zoom View, or adjust by dragging the X symbol to the target center and clicking on Confirm .

Next, proceed to Point 4. Point 4 is a 4-quarter target so clicking on the 4-quarter target tracking button switches to the 4-quarter target addition mode.

Click in the vicinity of Point 4 in Video View. Adjust the search results of the center as necessary.

Then click on the Point Property button to modify the tracking parameters for Point 4 and click on the “Detailed Settings for Tracking Parameters” button on the Point Property screen.

The parameters are modified on the Detailed Settings for Tracking Parameters screen (Figure 33).

- Make the template size of the search area 300% x (no other changes can be made).

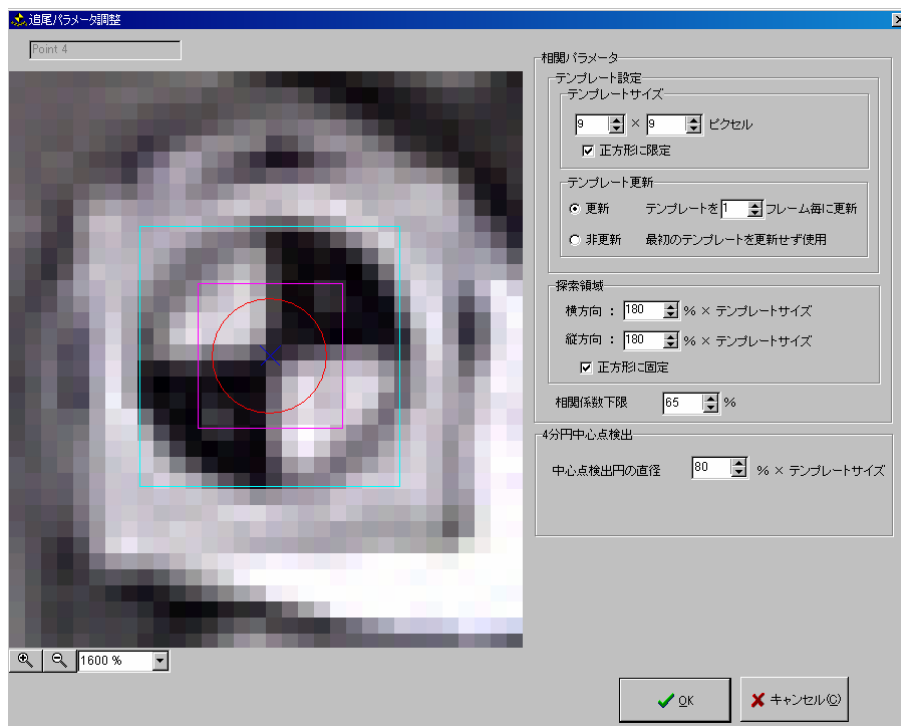


Figure 33 Screen before Tracking Parameters Details are Set for Point 4

Figure 34 is the screen after the parameters are modified.

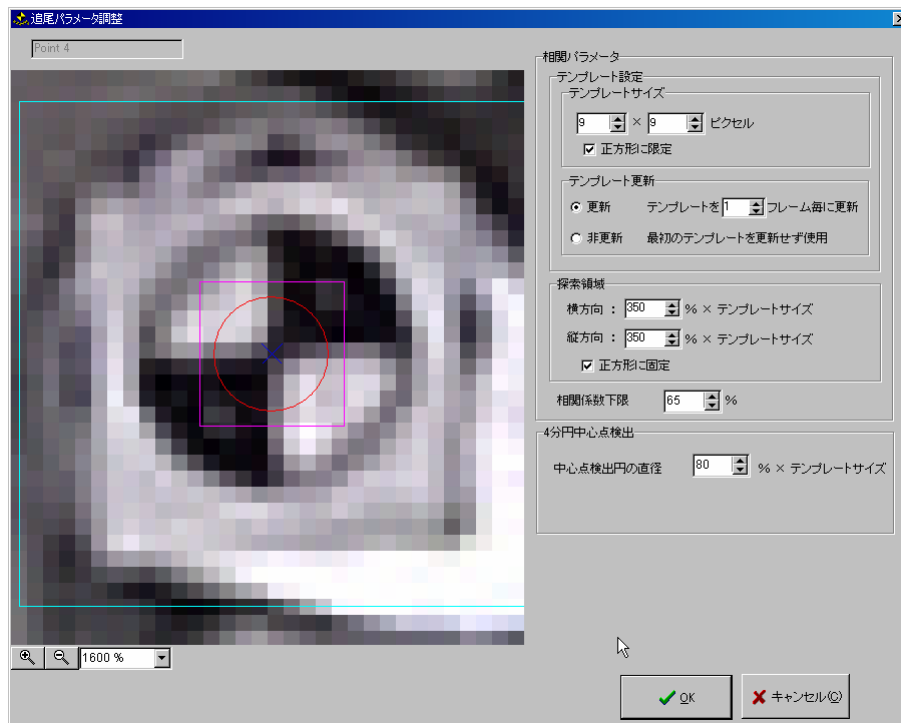


Figure 34 Screen after Tracking Parameter Details are Set for Point 4

Click “OK” after modifying the tracking parameters and then click on

“Apply” on the next screen.

Click “Start Tracking”. Tracking of Point 2, Point 3 and Point 4 will begin. (Since tracking of Point 0 and Point 1 has already been completed, they are not tracked.) Figure 35 shows the screens during tracking and immediately after tracking is complete.



Figure 35 Screens During Tracking and Immediately After Tracking is Complete

8) Setting Standard Lengths

Next, set the standard lengths.¹⁵

Next, set the standard lengths.¹

Select the “Secondary Calibration Sequence” menu on the tracking screen.

The screen in Figure 36 will appear.

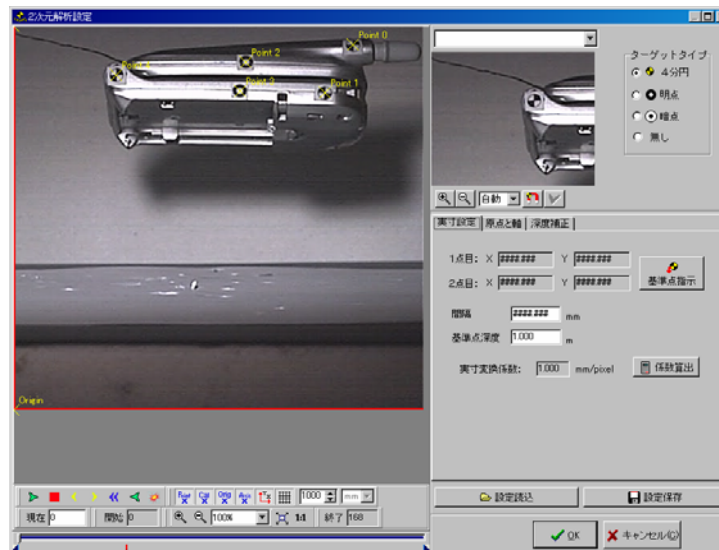


Figure 36 Two-dimensional Calibration

¹⁵ Standard lengths are set by inputting the gap between two points of an image. This enables a “coefficient for conversion to actual dimensions” to be determined for how many mm per pixel. Standard lengths can be set prior to tracking target marks.

Two-dimensional calibration is conducted on this screen, which also displays the labels such as “X Point 0” on the target tracked. In this tutorial, targets used for calibration are identical to the tracked targets so the labels interfere with the operations. Simply click on Display Tracking Point Label (Figure 37) at the bottom of the screen to hide this display.

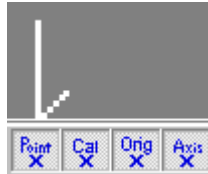


Figure 37 Display Tracking Point Label button

Standard lengths are set according to the following procedure.

- Click on “Designate Standard Points” (Figure 38).




Figure 38 Specify Standard Points button

- The cursor will show a label called Mark1. Click on the center of the mark on the left side (refer to Figure 14).(Figure 39)



Figure 39 Calibration of First Point

- The area clicked will be displayed in the zoom window. (Figure 40)¹⁶ If the center of the target searched has shifted, drag the center of the x mark to the center of the target and click the confirm button  to confirm the position of the target.

¹⁶ Clicking on Figure 39 automatically searches for the center of the mark and the results are shown in Figure 40.

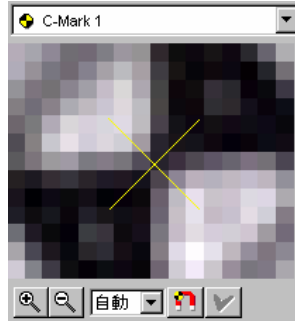


Figure 40 Adjusting Center Position

The coordinates of the first mark are displayed as Mark1, as shown in Figure 41.

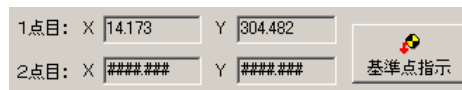


Figure 41 Screen after Confirmation of Calibration of First Point

- The cursor label will be Mark2 so click on the center of the mark on the right side in the same manner as for the first point. If necessary, adjust the center position with the zoom window.
- Input the actual dimensions between the two points in the appropriate column in mm units.
- Click “Calculate Coefficient” to calculate the conversion coefficient for the actual dimensions. In this example, the conversion coefficient for the actual dimensions is approximately 0.275. (Figure 42)

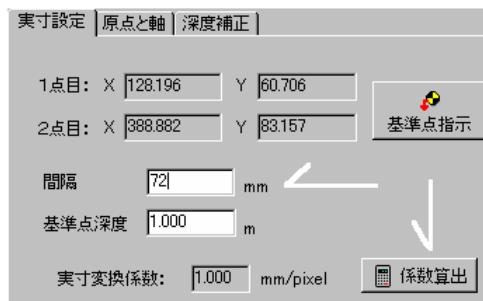


Figure 42 Screen upon Completion of Calibration

- Click “OK”. The calibration screen will close and return to the tracking window from Figure 19.

9) End Tracking

Once tracking is complete, click “OK” at the bottom of the tracking window screen to close. The 5 points tracked are entered on the left side of the main screen. (Figure 43)

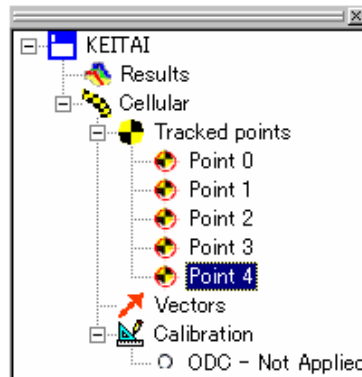


Figure 43 Enter Tracking Results

3. Notes

3.1 Movias Pro Edition

The three types of Movias Pro include Movias Pro 3D (3-dimensional analysis version), Movias Pro 2D (2-dimensional analysis version) and Movias Pro Basic (Low cost basic function version). The differences in these editions are shown in Table 1 below. (representative items only)

Function	3-dimensional analysis version	2-dimensional analysis version	Basic version
Number of tracking target points (max)	Unlimited (*1)	Unlimited (*1)	8
Number of tracking frames (max)	Unlimited (*1)	Unlimited (*1)	150
Axis rotation	○	○	×
Moving origin	○	○	○
Virtual points	○	○	×
Length, area, angle	○	○	○
Time, displacement	○	○	×
standard	○	○	○
Position, displacement, velocity, acceleration	○	○	×
Motion, force, energy, momentum	○	○	○
Stick	○	×	×
3D analysis	○	○	×
Tracking result correction	○	○	1
Excel batch output function	Unlimited (*2)	Unlimited (*2)	2
Excel template function	Unlimited (*2)	Unlimited (*2)	
Analog waveform inport function	Unlimited (*2)	Unlimited (*2)	
Number of projects (max)			
Number of sequences (max)			

Table 1 Differences in Program Functions

*1: Depends on PC main memory.

*2: Depends on PC disk memory.

3.2 Projects and Sequences

Movias Pro uses “Sequences” to save the coordinate values and analytical results from the target mark tracking results. These correspond to Windows files. Normally, only one type of data is stored in a file but sequences are different in that they store multiple types of data, including tracking results and analytical results.

In Windows, folders are used to collect multiple files but in Movias Pro, projects are used to collect multiple sequences.

An example is when photography is conducted using two cameras for a single test. In this case, the tracking results and analytical results for each camera image are saved in two sequences and these are stored together in a single project.

Since any name can be assigned to the projects and sequences, if the project is named with the same name as the test number and the same name is given to various sequences as the camera number and the photograph location, it is easy to understand in the future.

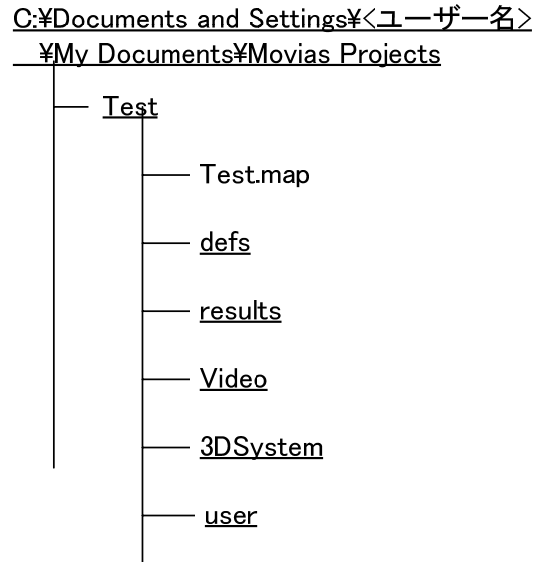
In Movias Pro, a project is created first and then, only the required sequences are sequentially created.

1) Project Folder Structure and Backup

Movias Pro creates sub-folders with the same name as the projects in the folder specified as “Project Folder” and projects are saved here.

For example, there is a project named “Test” in the project folder set in Movias Projects in My Documents. At this point, a project folder Test is created in the same manner as that in Figure 44 that follows.

Several folders used for project files Test.map and data are created.



(下線が引いてあるものがフォルダです)

Figure 44 Project Folder Structure

If creating a backup of a project, backup the entire contents and structure of the project folder Test without making any changes.

Note:

If saving to a CD-R as backup and then the backup data is written to the hard drive from the CD-R, there will be specialized attributes when read. Therefore, backup after compressing the individual project folders using the ZIP format.

2) Data Tree

Data trees are used in Movias Pro to graphically express data. Creating a project or sequence displays these affiliations at the left side of the Movias Pro screen, as shown in the example in Figure 45.

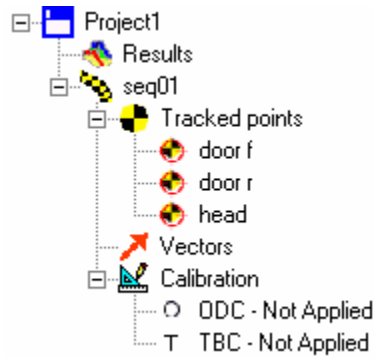


Figure 45 Example of a Data Tree

Project1 is the project in the figure while seq01 is the sequence contained in Project1.

3.3 Automatic Tracking

In Movias Pro, the movement of target marks is tracked automatically using an AVI file. This describes automatic tracking of target marks.

3.3.1 Types of Target Marks that are Automatic Tracking Targets, and the Tracking Method

In Movias Pro, there are four types of target marks that are automatic tracking targets, including 4-quarter marks, solid marks, shaded marks and image correlation marks.

1) 4-quarter Marks

4-quarter marks are round or square target marks divided into four sections, as shown by the example in Figure 46.



Figure 46 Examples of 4-quarter Marks

In Movias Pro, first the image correlation is determined and the mark and its position are found. Next, the position of the center of gravity for the mark is used to divide the mark into 4 regions that detect sub-pixels.

2) Solid Marks and Shaded Marks

As shown by the example in Figure 47, solid marks are formed of a light spot (white spot) on a dark background and shaded marks are formed of a dark spot on a shaded background.



Figure 47 Examples of Solid Marks and Shaded Marks

In Movias Pro, first the image correlation is determined and the mark and its position are found. Next, the position of the center of gravity for the object where the correlation contains the maximum amount of points is detected by sub-pixels. Either the center of gravity area method or the center of gravity area of luminance method can be used for detecting the position of the center of gravity.

3) Correlation Marks

A correlation mark is a tracking mark based only on image correlation. In this case, the image correlation is determined and tracking performed on the section with the highest correlation (the section that most resembles the image).

3.3.2 Tracking Parameters

In Movias Pro, appropriately determining several parameters is essential when target marks are automatically tracked. These parameters are called "Tracking Parameters". A description of these tracking parameters is given next.

1) Correlation Parameters

First is a description of the correlation parameters of 4-quarter marks, solid marks, shaded marks and image correlation marks

The four parameters for correlation parameters include template size, update template, search range and lower limit for the coefficient of correlation.

1-1) Template Size

A template is an original image that is made the standard for correlation.

The size of the template is set in pixels.

Movias Pro detects the image with the greatest correlation with this template. The size of the template affects the tracking velocity.

1-2) Update Template

This determines whether or not the template is updated with each frame.

With 4-quarter marks, solid marks and shaded marks, it is not necessary to update from the default setting (updates with each frame).

Correlation marks are not generally updated since the accuracy detecting the center of gravity point decreases as the template is updated. However, if the target is rotating or changing form, since updating the template is necessary, update at the lowest possible level.

1-3) Search Range

The search range searches the area with the highest correlation. In other words, it searches for the area with the highest correlation while slowly moving the template image within the search range.

The size of the search range is set as a percentage (%), based on the template size. If the target has a high motion velocity, make the search range larger.

If there are other targets in the same area, make the search range smaller to avoid identification errors.

The size of the search area affects the tracking velocity.

1-4) Lower Limit for Coefficient of Correlation

The degree for the coefficient of correlation can be numerically expressed from 0 to 100.

With a coefficient of correlation at 100, the two images are perfectly matched and as the number decreases, the degree of correlation decreases. During automatic tracking, if the coefficient of correlation reaches the lower limit, tracking is suspended and further treatment is left to the operator. (It is possible to automatically avoid suspension via user settings.)

2) Parameters for 4-quarter marks

2-1) Diameter of Circle for Detection of Center Point

This parameter determines the diameter of the circle to detect the center point of the 4-quarter mark. The circle detected must be contained within the target mark.

3) Parameters for Solid/Shaded Marks

3-1) Binary Threshold Value

Determines at what level of luminance the solid/shaded points are identified.

3-2) Update Each Frame (Relative to Max/Min Luminance)

The threshold value is updated for each frame, using the N% max/min luminance of a template as the threshold value. It is effective with images where the brightness gradually changes.

3-3) Fix All Frames

Specifies the threshold value using luminance [0-255].

3-4) Center of Gravity Calculation Method

Specifies the way to determine the center of gravity for the range, based on a threshold value.

3.3.3 Method of Setting Tracking Parameters

1) 4-quarter Marks

The size of the circle for detecting the point of the center of gravity depends on the image quality, but should be set for the 4-quarter marks according to the example in Figure 48.

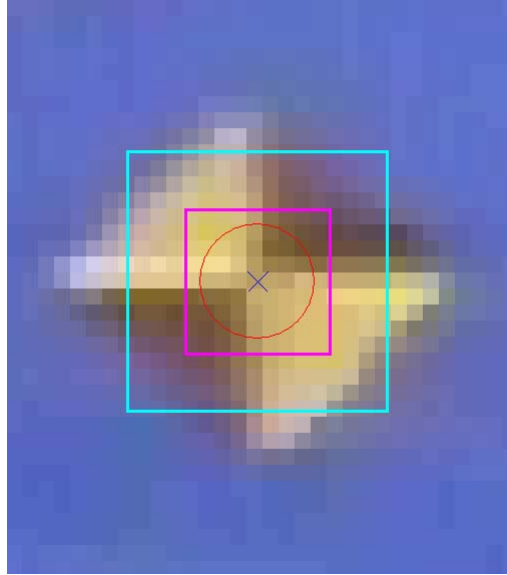


Figure 48 Example of Tracking Parameters for 4-quarter Marks

The accuracy improves slightly with a larger circle but if the mark disappears, automatic tracking becomes impossible. Also, the accuracy may deteriorate when the shape is altered.

The accuracy deteriorates slightly with a smaller circle and if the mark disappears or changes shape, automatic tracking may still be possible.

2) Solid/Shaded Marks

Set the size of the template for the solid/shaded marks according to the example in Figure 49.

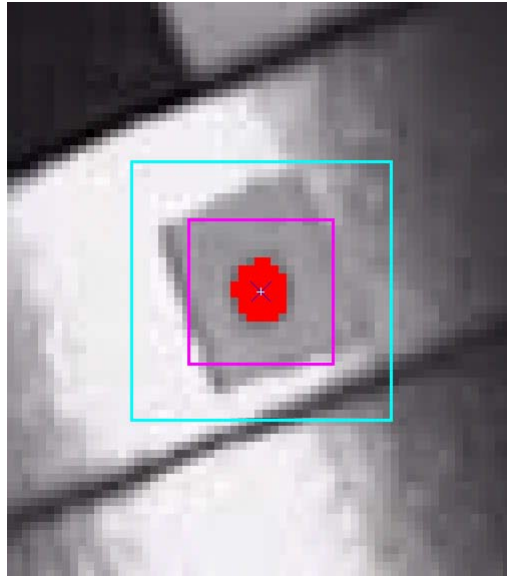


Figure 49 Example of Tracking Parameters for Solid/Shaded Marks

Make the size of the template so the template frame does not touch the solid/shaded points.

Adjust the binary threshold value and extract the solid/shaded point from the background.

3) Correlation Target

Adjust the template size so the identifies are contained within the template. Updating the template is essential with targets that have significant rotation or changes in shape.

Since the tracking accuracy decreases as the template is updated, adjust the parameters so they are updated at the lowest possible level.

If the target rotates slightly or changes form, the coefficient of correlation declines so the best result is achieved by not updating the template.

If tracking a small object that moves on a background, set so not much of the background is contained in the template.

3.4 Depth Correction

Basically, with 2-dimensional analysis, the movement of the object is analyzed on the plane of the activity along the same plane perpendicular to the camera.

If photographing objects with movement in the back, the area nearest the camera appears larger than those farther away. Objects farther away appear smaller than those closer.

As a result, to analyze activity on multiple planes of varying distances, correcting the difference in the size and position of this photographic distance (the distance from the camera to the object) is necessary. This is called **depth correction**.

The depth correction function is available in Movias Pro 2-dimensional analysis, making it possible to perform quantitative motion analysis on multiple planes by absorbing the differences in depth. (However, correction is not possible if the photographic distances gradually change so there may be times when the movement within the optical axis of the camera is limited.)

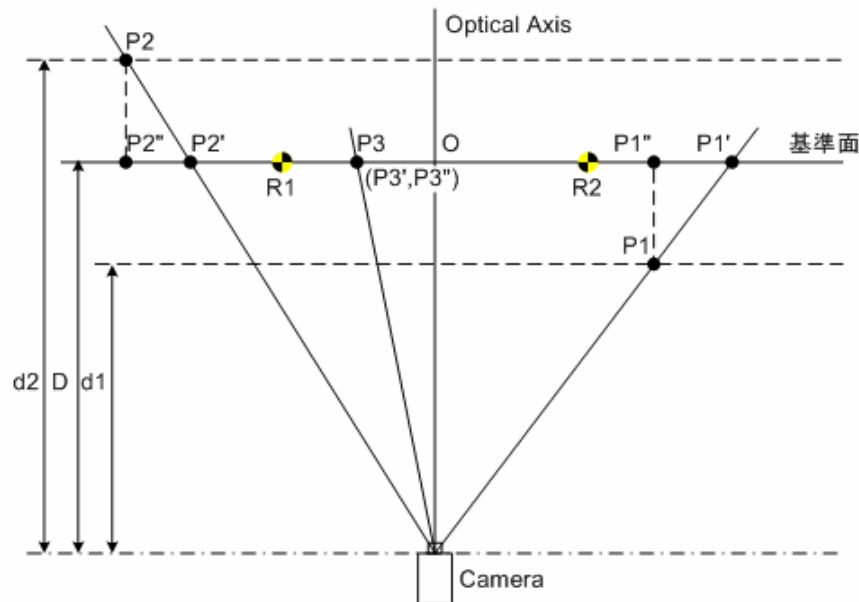


Figure 50 Depth Correction

In Figure 50,

O : center of screen

d1 : Distance from the camera on the plane where point P1 is located

d2 : Distance from the camera on the plane where point P2 is located

D : Distance from the camera on the plane (base plane) where the actual converted standard points (R1,R2) are located, along with point P3

P1,P2,P3 : Actual position of measurement points P1,P2,P3

P1',P2',P3' : Perceived position of measurement points P1,P2,P3
 P1'',P2'',P3'' : Position of measurement points P1,P2,P3 after depth correction

Therefore,

the depth correction coefficient for point P1 is $\frac{d1}{D}$

the depth correction coefficient for point P2 is $\frac{d2}{D}$

and the depth correction coefficient for point P3 is $\frac{D}{D} = 1$.

For specific calculations,

With the coordinates of the measurement points before correction as (x, y) the depth correction coefficient for the measurement points as α , the coordinates of the center of the screen as (cx, cy) and the coordinates of the measurement points after depth correction as (X, Y) , it becomes

$$X = cx + (x - cx) \times \alpha$$

$$Y = cy + (y - cy) \times \alpha$$

As clearly shown in this equation, measurement point P2 appears small due to the distance from the base plane and since $\frac{d2}{D} = \alpha$ has a value greater than 1, it is magnified with the calculation. On the other hand, measurement point P1 appears large due to the distance from the base plane and since $\frac{d1}{D} = \alpha$ has a value less than 1, it is compressed with the calculation.

3.5 3-dimensional Analysis

3.5.1 Calibration Chart and Control Points

Calibration information is essential for performing 3-dimensional analysis. There is a calibration chart that is photographed with the camera. The calibration chart displays several examples as solid structures, shown in Figure 51.

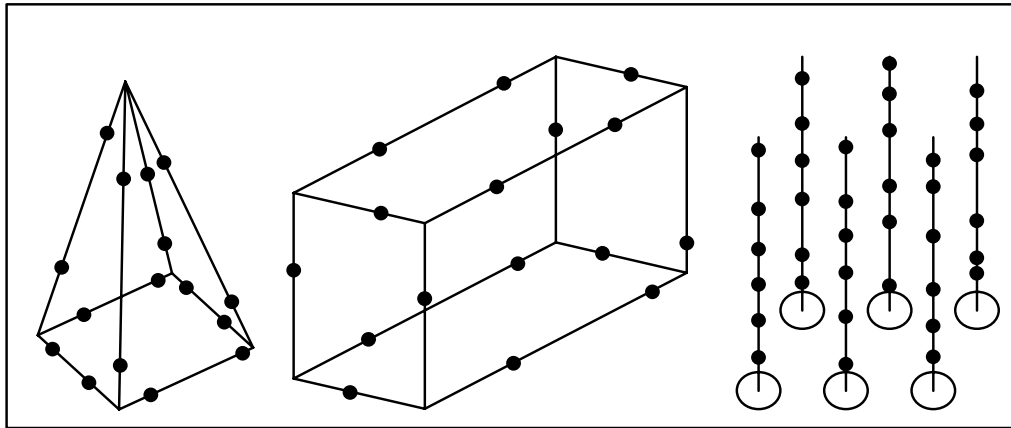


Figure 51 Calibration Chart

The black points on the calibration chart are control points. Measuring the coordinates (X, Y and Z) of the actual 3-dimensional space of the control points is required for 3-dimensional analysis. Ideally, the calibration chart should be a size large enough to cover all of the space to be analyzed. Also, the control points should have a random arrangement.

3.5.2 Calibration Chart Photography and Data Input

Photograph this calibration chart with multiple cameras. It doesn't matter whether the target for analysis (subject) or the calibration chart is photographed first. However, the following precautions need to be taken.

- Do not change the position or angle of view (focus distance of the lens) of the camera when photographing the subject or calibration chart.
- All of the control points should be visible from all of the cameras used for photography.

Next, simultaneously measure (input) the control point positions for each camera with each camera and input the actual 3-dimensional coordinates of the control points. At this point, the process for the measurement/input of the control points is identical.

3.5.3 3-dimensional Data Structure

As noted in 3.2, in Movias Pro, the tracking results and analysis results are processed and saved as sequences. The two types of sequences include 2D sequences for 2-dimensional analysis and 3D sequences for 3-dimensional analysis. 3D sequences are created to build 3-dimensional data. 3D sequences are created by combining multiple 2D sequences with calibration data.

3.6 Models

In Movias Pro, it is possible to find the center of gravity for a body based on human body segment models. The model is described using an example. The body is often divided into multiple sections (segments) when analyzing the movements of the body and the position of the center of gravity is determined for each section. The center of gravity for the entire body is then determined by combining the centers of gravity for each section.

When determining the center of gravity for each section, the relationship between the position of the representative point for that section (primarily joints) and the position for the center of gravity for that section is taken into consideration, along with the ratio of the weight for the section relative to that of the weight of the entire body (body weight).

This is called the human body model and there are various types, depending on the researcher. The human body model employed by this software fulfills the following conditions.

- The coordinates of the center of gravity for each section of the body are determined from at least two points that are representative of those sections.
- Ratios for the weights of each section of the body relative to the total body weight are assigned.

3.6.1 Description of the Matsui Model

The Matsui model is given as an example of the model of the human body. Next is a chart of the points input with the Matsui model and the segments formed by these combinations.

- Chart of Input Points

Input Point	Name of Region
1	Right fingers
2	Right wrist
3	Right elbow
4	Right shoulder
5	Left fingers
6	Left wrist
7	Left elbow
8	Left shoulder
9	Right toes
10	Right ankle

Input Point	Name of Region
11	Right knee
12	Right hip
13	Left toes
14	Left ankle
15	Left knee
16	Left hip
17	Top of head
18	Back of the head
19	Top of spine
20	Bottom of spine

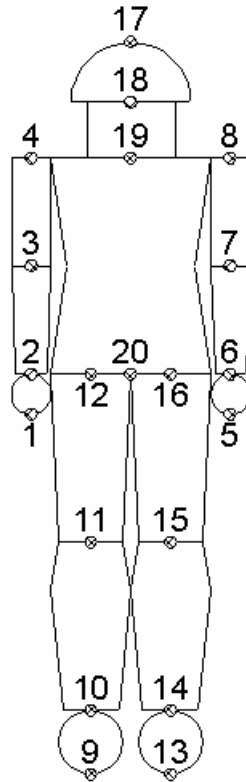


Figure 52 Input Points

- Each Section (Essential Segments)

Segment Number	Section Name	Input Number for Section	Wt. Coefficient %	Center of gravity Coefficient %
1	Head	17, 18	4.4	37.0, 63.0
2	Neck	18, 19	3.3	50.0, 50.0
3	Spine	19, 20	47.9	48.0, 52.0
4	Right upper arm	4, 3	2.65	54.0, 46.0
5	Right forearm	3, 2	1.5	59.0, 41.0
6	Right hand	2, 1	0.9	50.0, 50.0
7	Left upper arm	8, 7	2.65	54.0, 46.0
8	Left forearm	7, 6	1.5	59.0, 41.0
9	Left hand	6, 5	0.9	50.0, 50.0
10	Right thigh	12, 11	10.0	58.0, 42.0
11	Right calf	11, 10	5.35	59.0, 41.0
12	Right ankle	10, 9	1.9	50.0, 50.0
13	Left thigh	16, 15	10.0	58.0, 42.0

14	Left calf	15, 14	5.35	59.0, 41.0
15	Left ankle	14, 13	1.9	50.0, 50.0

- Center of Gravity for Human Body (Composite Segments)

Number of Composite Segment	Name	Essential Segment Numbers
1	Entire body	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15

- Description

A description is provided using the right forearm as an example. In the chart of each section, the input points on the right forearm include the right elbow and the right wrist. The weight is 1.5% of the body weight. The center of gravity for the right forearm section is calculated from coordinates of the right elbow and the right wrist as follows.

The X coordinates for the right forearm section center of gravity are X_G , the X coordinates for the right elbow (point number 3) are X_3 , and the X coordinates for the right wrist (point number 2) are X_2 , for

$$X_G = X_3 \times 0.59 + X_2 \times 0.41. \text{ (Y and Z coordinates are identical)}$$

In this manner, the center of gravity for each section is determined and the center of gravity for the entire body is calculated from these.

In addition to the human body, models can be adapted to a wide range of analysis for machinery and equipment.

The following describes the models.

1) Input Points

Names and codes are given to the input points (measurement points) used with models. The maximum number of input points that can be used with models is 30 per model.

2) Virtual Points

Defines the virtual points based on input points. A maximum of 10 virtual points can be defined in a model.

3) Essential Segments

Shows points (input points or virtual points) for essential segments as well as the weight coefficient and center of gravity coefficient. A maximum of 20 essential segments can be defined in a model.

4) Composite Segments

Shows the combinations of essential segments. A maximum of 10 composite segments can be defined in a model.

5) Sticks

Shows the method of connecting points when drawing a stick figure using points found in models. A maximum of 10 sticks can be defined in a model.

Models are written in ASCII text files. This file is called a model defined ASCII file. Next is a description of the details in a model defined ASCII file.

3.6.2 Model Defined ASCII File

Model defined ASCII files are ASCII text files for the models. Five items can be included in the files, including the input points, virtual points, essential segments, composite segments and sticks.

Notations are performed by columns. The type and formation method are listed in columns.

Columns are called records.

The first character is a / (slash) to validate the record and contains information relating to the model that can be viewed. Other records show comments and can be ignored.

Next is a description of the model defined file structure and format. Finally, an example of a model defined file for the Matsui model is provided.

1) Model Defined ASCII File Structure

		Defined Record		
		No.	Type of Point	Parameter
Input Points	Max 30	1	Input point (IP)	
		2		
		:		
		:		
		i		
Defined Points	Max 10	i+1	Virtual Point (VP)	
		:		
		:		
		:		
		j		
	Max 20	j+1	Essential segments (ES)	
		:		
		:		
		:		
		k		
	Max 10	k+1	Composite segments (CS)	
		:		
		:		
		:		
		M		
Sticks	Max 10	1	Sticks (STK)	
		2		
		:		
		:		
		N		

2) Model Defined ASCII File Format

2-1) Common Data for Each Item

／No.	Type of Point	Code	Name	→ the following varies by type of point.
------	---------------	------	------	--

- Number

Input points, virtual points, essential segments and composite segments are numbered starting with the number 1. New sticks are numbered starting with the number 1. Refer to the structure on the previous page for the definition of points and the number of maximum definitions.

- Type of Point

The type of point is expressed in 2-3 letters as follows:

IP: Input Point

VP: Virtual Point

ES: Essential Segment

CS: Composite Segment

STK: Stick

- Code

Code numbers for points use 1~5 letters as desired

- Name

1~20 letters can be input on the keyboard, excluding the
", " (comma) and "; " (semi-colon).

- Special Marks

	Expressed in the Description	Notation in the file
Item punctuation mark		"," (comma)
Punctuation mark in item		;" (semi-colon)
Record complete mark	↓	CR + LF

2-2) Input Point Records

／No.	IP	Code	Name	↓
------	----	------	------	---

2-3) Virtual Point Records

No.	VP	Code	Name	Type	Point No.			Coeff.		↓
					①	②	③	①	②	

- Type
Type number for the virtual point. Number from 1~9.
- Point Number
Number of essential structure point. Point of number lower than the defined virtual point. Input from 0~3 depending on the type of virtual point.
- Coefficient
Input from 0~2 depending on the type of virtual point. The numerical format is \pm #####.###

2-4) Essential Segment Records

Essential segments are composed of input points or virtual points (excluding vectors).

No.	ES	Code	Name	Type	Point No.					Weight Coeff.
					①	②	③	④	⑤	

		Center of Gravity Coefficient ↓							
		①	②	③	④	⑤			

- Point Number
Number of essential point. Input from 2~5. Whole numbers in 1~2 columns.
- Weight Coefficient
Weight of the essential segment a total weight of 100. (For example, at a total weight of 80kg, if the essential segment is 10kg, the weight coefficient is 12.5) The numerical format is #####.###
- The center of gravity coefficient is the same as the input amount for the point number. The weight is apportioned for each point with an essential segment mass of 100. The numerical format is \pm #####.###.

2-5) Composite Segment Records

／No.	CS	Code	Name	Point Number					↓
				①	②	· · · · ·	⑩		

- Point Number

Number of essential segment. Input 2~20. Whole numbers in 1~2 columns.

2-6) Stick Records

／No.	STK	Code	Name	Color	Point Number				Mark Number	↓
					①	②	· ·	⑩		

- Color

Color number of CRT output. Number from 1~8.

- Point Number

Number of essential segment. Input 1~10. Whole numbers in 1~2 columns.

- Mark Number

Input if 1 is input for the point number in the previous item. Whole numbers in 1 column.

3) Example of File

Next is an example of a model defined ASCII file with the Matsui model.

MATSUI.MDL		Dec. 17, '93
		nac Inc.
MODEL DEFINITION FILE for the HUMAN BODY GRAVITY CENTER based upon the MATSUI model.		
MEASURED POINT DEFINITION BLOCK		

3.7 3D ASCII File

Movias Pro reads the coordinate data for tracking point from the ASCII text file, creates a sequence from this and has a function that can express the results as a graph. The two types of sequences include 3D sequences for 3-dimensional analysis and 2D sequences for 2-dimensional analysis so both can be created from ASCII text files. 3D ASCII files are used to create 3D sequences while 2D ASCII files are used to create 2D sequences. 3D ASCII files are described in this section and 2D ASCII files are described in the next section.

3.7.1 3D ASCII File Example

First is an example of a file. Then, is an example of a 3D ASCII file showing 3 data points (photographic speed of 0.1sec at 1000fps).

```
#
# Movias Pro 3D ASCII FILE (Sample)
#
#   File Name : *****.***
#   Date : April 1st 2003
#
# F-Seq Point   Time      X Data      Y Data      Z Data
# 1,    0,    0.0,    0.000,    9.848,    -3.420
# 2,    0,    1.0,    0.628,    9.816,    -3.584
# 3,    0,    2.0,    1.253,    9.782,    -3.746
# :      :      :      :      :      :
# :      :      :      :      :      :
# 99,   0,   99.0,   -0.628,   -3.090,   -8.830
# 100,  0,  100.0,    0.000,   -3.256,   -8.746
# 1,    1,    0.0,   10.000,    2.548,    5.142
# 2,    1,    1.0,    9.980,    2.681,    5.267
# 3,    1,    2.0,    9.921,    2.749,    5.587
# :      :      :      :      :      :
# :      :      :      :      :      :
# 99,   1,   99.0,    9.980,    9.164,    2.498
# 100,  1,  100.0,   10.000,    9.543,    2.175
# 1,    2,    0.0,   10.000,   -8.145,    0.124
# 2,    2,    1.0,   10.608,   -7.846,    0.128
# 3,    2,    2.0,   11.174,   -7.175,    0.121
# :      :      :      :      :      :
# :      :      :      :      :      :
# 99,   2,   99.0,    9.352,    0.048,    0.130
# 100,  2,  100.0,   10.000,    0.263,    0.127
#
# End of file
```

3.7.2 File Format

1) Structure

The files are in columns.

The two types include a comments column to write notes and a data column to include data.

2) Comments Column

The column starting with # is the comments column.

A description of the contents of the file follows the #. There is no prescribed format and can include anything. When Movias Pro reads the file, columns beginning with # are disregarded.

3) Data Row

3-1) Structure

The data row has the following structure.

FSN	,	PN	,	TIME	,	DATA-X	,	DATA-Y	,	DATA-Z	Enter
-----	---	----	---	------	---	--------	---	--------	---	--------	-------

3-2) FSN

Whole numbers starting with 1 are written as half-width characters using the frame sequence number.

3-3) PN

Whole numbers starting with 0 are written as half-width characters using the point number.

3-4) TIME

Time data. Actual numbers are written as half-width characters using the time data in milliseconds starting with 0, as shown in the example.

3-5) DATA-X,-Y,-Z

Point coordinate data. Actual numbers are written as half-width characters as shown in the example.

3-6) , (comma)

Data punctuation. The half-width comma is written. For ease of viewing, several spaces or a tab can be inserted after the comma.

3.8 2D ASCII Files

The format for 2D ASCII files is an abbreviated form of the 3D ASCII file format, with a comma just before DATA-Z. If using the same format as 3D ASCII files, Movias Pro ignores the DATA-Z when reading it.

3.9 CSV Graph Data in Movias Format

Movias Pro can import/export graph data using text data punctuated with commas (CSV format). The two types of file formats include a time graph (XT graph) and a correlation figure (XY graph) like a trajectory figure. Imported graphs can be simultaneously played back with AVI images or graphs analyzed by Movias.

3.9.1 File Format

The file format is a text data file (CSV file) separated by a comma (,).

Files are constructed of the following three blocks.

- Header (Fixed Length)
Rows 1~29, contents for each row can be determined.
- Data section (Variable Length)
From row 30 to "EOD", contains graph data.
- Comments section (Fixed Length)
From "EOD" to the end of the file, includes comments.

1) Header

The six parts of the header are constructed of 1) file identifier, 2) graph settings, 3) graph data information, 4) horizontal axis settings, 5) data channel settings, 6) channel data information.

Of these, 3) graph data information and 6) channel data information are only added when exported and are disregarded during imports. “#” is added to the beginning of the name of each of these items.

1-1) File Identifiers

Row Number	Details	Format	Notes
1	File format and version identifier	Movias**GraphV## (all half-width) **:Graph format (XT for a time graph and XY with a correlation figure) ##:Version for this format (columns of half-width numerals) Ex.) For XT graph and Ver. 1.1 MoviasXTGraphV11	
2	Reserved		

1-2) Graph Settings

Settings for the entire graph, including graph title and number of data channels

Row Number	Item	Details	Format	Notes
3	Title	Graph Title	Text	*1)
4	SubTitle	Graph Sub-title	Text	
5	NDataCh	Number of data channels	Half-width number	
6	Creator	Creator of this file	Text	

*1) Note the creator and version of this file.

1-3) Graph Data Information

Graph data information added when Movias is output

Row Number	Item	Details	Format	Notes
7	#NData	Data number	Half-width number	*2)
8	#FrameInterval[ms]	Time interval between frames	Half-width number	*2)

*2) Disregarded when importing.

1-4) Horizontal Axis Settings

Horizontal axis settings including titles of the horizontal axis and scale

Row Number	Item	Details	Format	Notes
9	XAxisCaption	X axis caption	Text	*3)
10	XUnit	X axis unit	Text	
11	XMin	X axis minimum display value	Half-width decimal or "Auto"	
12	XMax	X axis maximum display value	Half-width decimal or "Auto"	
13	XChName	Name of X axis data channel	Text (only used with XT graphs)	

*3) If "Auto" is specified in Xmin, Xmax, the scale of the axis will be automatic.

1-5) Data Channel Settings

Setting for each channel, including the vertical axis title and scale, line type and color

Row Number	Item	Details	Format	Notes
16	ChNo	Channel number	Half-width number 1,2,3,4....	
17	ChName	Channel name	Text	
18	Color	Color	Name of color or number of color (Refer to below)	
19	Line Style	Line style	Line number (Refer to below)	
20	YAxisCaption	Y axis caption	Text	
21	YUnit	Y axis Unit	Text	
22	YMin	Y axis minimum display value	Half-width decimal or "Auto"	*4)
23	YMax	Y axis maximum display value	Half-width decimal or "Auto"	*4)
24	YChName	Name of Y axis data channel	Text	
25	XChName	Name of X axis data channel	Text (only used with XY graphs)	

*4) If "Auto" is specified in Ymin, Ymax, the scale of the axis will be automatic.

Caution: If the same Y axis unit extends for more than two rows, these axes will be combined into one axis. In this case, the Y axis setting will be that of the first axis set.

- Color











Color Name	Color	Color Name	Color
Yellow	Yellow	Maroon	Maroon
Fuchsia	Magenta	Navy	Navy blue
Aqua	cyan	Purple	Purple
Red	Red	Teal	Teal
Blue	Blue	Black	Black
Green	Green	Gray	Gray
Lime	Lime	Silver	Silver
Olive	Olive	White	White

- Color number: Shown with 16 decimal places in the sequence of blue, green, red after the pound (#).

The format is #XXYYZZ, where XX is Blue luminance, YY is Green luminance and ZZ is Red luminance.

For example, #00FF00 is green with the highest luminance.

- Line Style

Line Number	Line Style	Legend
1	Solid line (width 0)	
2	Dashed line (width 0)	
3	Dotted line (width 0)	
4	Single dashed line (width 0)	
5	Double dashed line (width 0)	
10	Solid line (width 1)	
6	Solid line (width 2)	
11	Solid line (width 3)	
7	Solid line (width 4)	
12	Solid line (width 5)	

1-6) Channel Data Information

Information for each channel added when Movias is output

Row Number	Item	Details	Format	Notes
15	#ExcelRange	Channel data cell range in Excel	Excel standard Ex) B12:C20	
26	#Min	Minimum value for channel data	Half-width decimal	
27	#Max	Maximum value for channel data	Half-width decimal	
28	#MinTime	Time [ms] when channel data is at a minimum	Half-width decimal	
29	#MaxTime	Time [ms] when channel data is at a maximum	Half-width decimal	

2) Data Section

Time series data for each channel

Row Number	Details	Format	Notes
30	Data section items	(XT graph) Time[ms], Ch1Y, Ch2Y, Ch3Y, Ch4Y..... (XY graph) Time[ms], Ch1X, Ch1Y, Ch2X, Ch2Y, Ch3X, Ch3Y, Ch4X, Ch4Y.....	
31~EOD	Rows for time and channel data	(1 st row) Time data. Msec units, half-width decimal. Time segments are all regularly spaced. (after the 2 nd row) Numerical channel data. Half-width decimal. Data arranged identical to the 30 th row	*5) *6)

*5) If there is no data (points not tracked) ""(blank), and if there is no data outside the graph range, (if the graph data was copied from sequences with a different time range), it is noted with "#N/A".

*The character string does not change if there is no data after Movias Pro Ver1.61.

Select "Ver. 1.60 Format" in the "File>Settings>General Settings>Export" menu to use the existing settings.

*6) If there are comments after the data string, "EOD" will be entered in the first string of the next row in the last data.

If there are no comments, EOD can be abbreviated.

3) Comments Section

In Movias, comments can be displayed for each graph.

The comments section is from the first row of the "EOD" to the end of the file.

Comments are only captured in the first row and if comments are entered, they are also entered into the comment section of Movias.

This block can be abbreviated.

Format: Text

3.9.2 Graph Settings and Managing Graphs

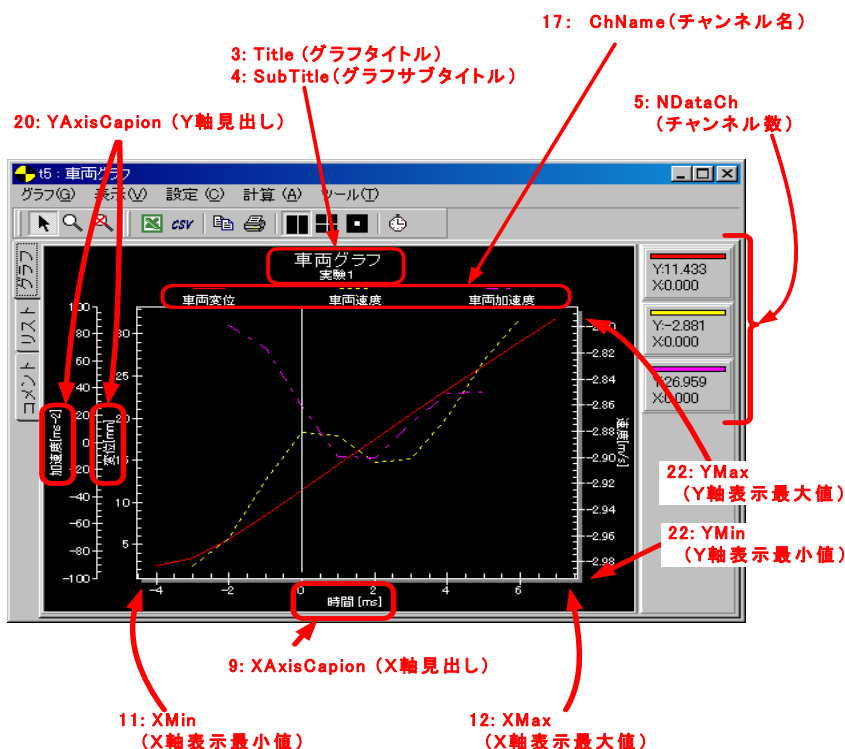


Figure 53 Graph Settings and Managing Graphs (Graph Tab)

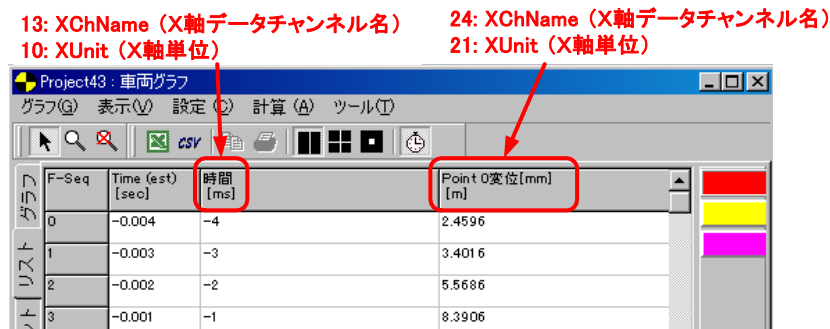


Figure 54 Graph Settings and Managing Graphs (List Tab)

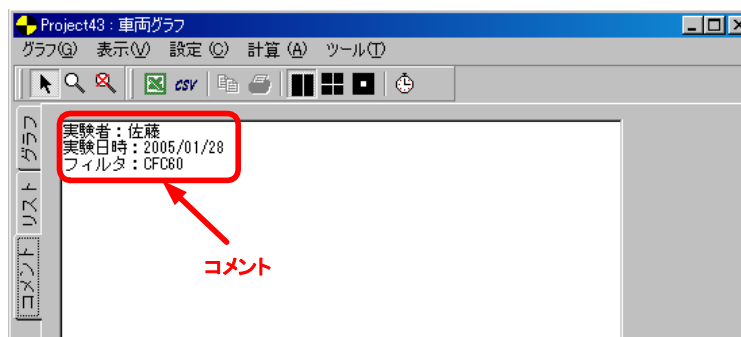


Figure 55 Graph Settings and Managing Graphs (Comments Tab)

3.9.3 File Examples

1) Example of Time Graph (XT Graph)

	A	B	C	D
1	MoviasXTGraphV11			
2				
3	Title	Vehicle Graph		
4	SubTitle	Test1		
5	NDataCh	3		
6	Creator	MoviasPro		
7	#NData	12		
8	#FrameInterval[ms]	1		
9	XAxisCaption	Time [ms]		
10	XUnit	ms		
11	XMin	Auto		
12	XMax	Auto		
13	XChName	Time		
14				
15	#ExcelRange	B31:B42	C31:C42	D31:D42
16	ChNo	1	2	3
17	ChName	Vehicle displacement	Vehicle velocity	Vehicle acceleration
18	Color	Red	blue	#FF00FF
19	LineStyle	1	3	4
20	YAxisCaption	Displacement [mm]	Velocity [m/s]	Acceleration [ms ⁻²]
21	YUnit	m	m/s	ms ⁻²
22	YMin	Auto	Auto	-100
23	YMax	Auto	Auto	100
24	YChName	Point 0 displacement [mm]	Point 0 velocity [m/s]	Point0 acceleration [m/s ²]
25				
26	#Min	2.4596	-2.9832	-11.713
27	#Max	31.811	31.811	85.973
28	#MinTime	-4	-3	2
29	#MaxTime	7	7	-2
30	Time[ms]	Ch1Y	Ch2Y	Ch3Y
31	-4	2.4596		
32	-3	3.4016	-2.9832	
33	-2	5.5686	-2.9621	85.973
34	-1	8.3906	-2.9171	68.885
35	0	11.433	-2.8809	26.959
36	1	14.491	-2.8835	-10.944
37	2	17.521	-2.904	-11.713
38	3	20.5	-2.9013	14.235
39	4	23.412	-2.8695	36
40	5	26.254	-2.8252	36.987
41	6	29.041	-2.7936	

42	7	31.811		
43	EOD			
44	Tester: Sato			
45	Test Date: 2005/01/28			
46	Filter: CFC60			

2) Example of Correlation Figure (XY Graph)

	A	B	C	D	E	F	G
1	MoviasXYGraphV11						
2							
3	Title	Diagram of vehicle					
4	SubTitle						
5	NDataCh	3					
6	Creator	MoviasPro					
7	#NData	18					
8	#FrameInterval[ms]	1					
9	XAxisCaption	X coordinates[m]					
10	XUnit	m					
11	XMin	Auto					
12	XMax	Auto					
13							
14							
15	#ExcelRange	B31:C48	D31:E48	F31:G48			
16	ChNo	1	2	3			
17	ChName	Point 0	Point 1	Point 2			
18	Color	Yellow	Fuchsia	Aqua			
19	LineStyle	1	1	1			
20	YAxisCaption	Left doorRear doorFront trajectory					
21	YUnit	m	m	m			
22	YMin	Auto	Auto	Auto			
23	YMax	Auto	Auto	Auto			
24	YChName	Y coordinates of	Y coordinates of	Y coordinates of			
25	XChName	X coordinates of	X coordinates of	X coordinates of			
26	#Min	0.37918	-0.15316	0.43286	-0.15308	0.48135	-0.23094
27	#Max	0.42791	-0.15171	0.48036	-0.1519	0.48904	-0.23002
28	#MinTime	17	0	17	0	17	14
29	#MaxTime	0	17	0	17	10	17
30	Time[ms]	Ch1X	Ch1Y	Ch2X	Ch2Y	Ch3X	Ch3Y
31	0	0.42791	-0.15316	0.48036	-0.15308		
32	1	0.42492	-0.15281	0.47765	-0.15291		
33	2	0.42186	-0.15176	0.47467	-0.1518		
34	3	0.41886	-0.15187	0.47169	-0.15212		
35	4	0.41596	-0.1526	0.46897	-0.15274		
36	5	0.4135	-0.1524	0.4662	-0.1524		
37	6	0.41035	-0.15263	0.46322	-0.15275		
38	7	0.40735	-0.15254	0.46023	-0.15254		

39	8	0.4045	-0.15179	0.45808	-0.15191		
40	9	0.40152	-0.15156	0.4551	-0.15178		
41	10	0.39894	-0.15096	0.45214	-0.15104	0.50684	-0.22939
42	11	0.39602	-0.15153	0.44938	-0.15188	0.50484	-0.23039
43	12	0.39348	-0.15211	0.44657	-0.15224	0.50234	-0.23073
44	13	0.39047	-0.15205	0.44352	-0.15227	0.49975	-0.23038
45	14	0.38751	-0.15228	0.44088	-0.15244	0.49717	-0.23094
46	15	0.38466	-0.15232	0.43812	-0.15245	0.49431	-0.2308
47	16	0.38212	-0.15198	0.43573	-0.15229	0.49188	-0.23054
48	17	0.37918	-0.15171	0.43286	-0.1519	0.48904	-0.23002

4. Reference Menu

4.1 Summary of Menu and Toolbar

A summary of the Movias Pro menu tree and each menu item is as follows.

1) Movias Pro Menu Tree

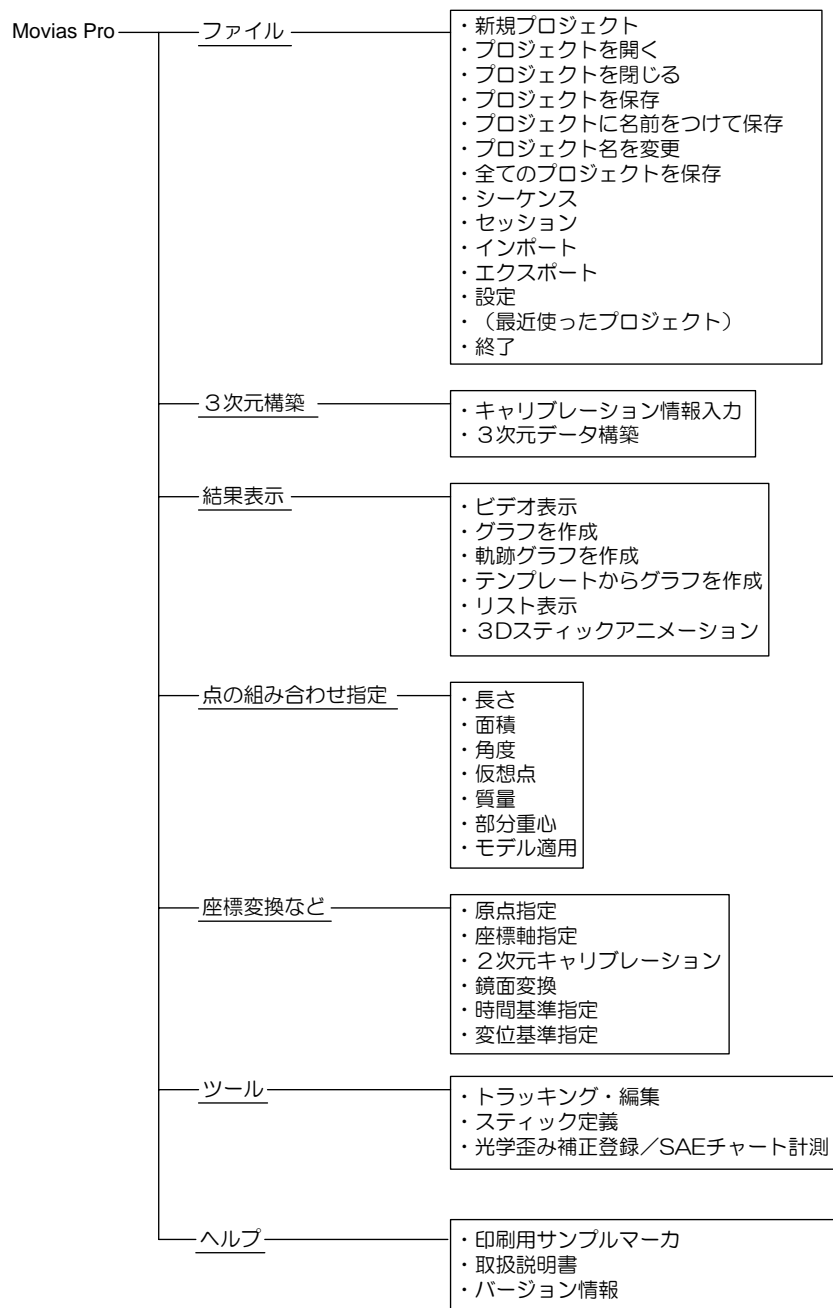


Figure 56 Movias Pro Menu Tree

2) File Menu

As shown in Figure 57, the functions of the “File” menu are as follows.

- Create new project or sequence.
- Open projects already created.
- Change the name of projects and save as a different name.
- Import Wave-in data.
- Output target mark coordinates that are the tracking results to text files.
- Edit default settings.
- Open the most recently used project

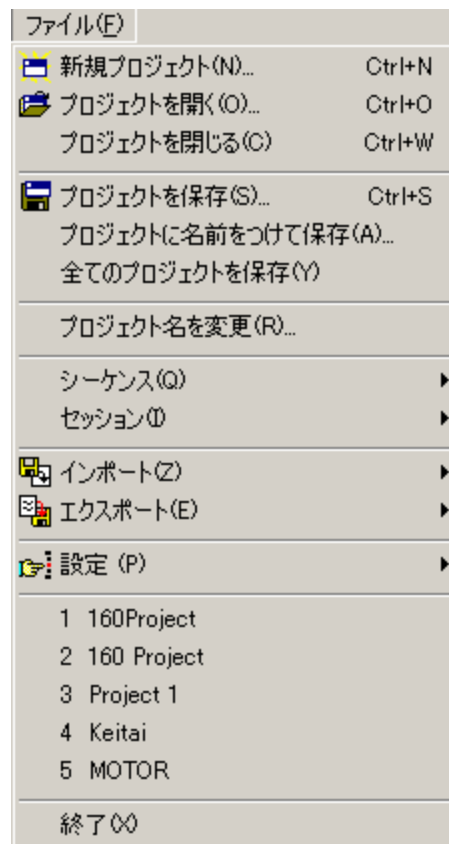


Figure 57 File Menu

3) 3-dimensional Structure Menu

As shown in Figure 58, the functions of the “3-dimensional Structure” menu are as follows.

- Measurement of the calibration chart images for 3-dimensional analysis, set 3-dimensional space coordinates for each control point.
- Create 3-dimensional analysis sequences by combining multiple 2-dimensional analysis data with the calibration chart data.

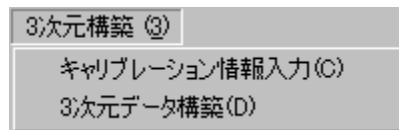


Figure 58 3-dimensional Structure Menu

4) Display Results Menu

As shown in Figure 59, the functions of the “Display Results” menu are as follows.

- Superimpose trajectory figures or stick figures on to AVI images. (2D, Basic edition)
- Displays analytical result data as a numerical list or graph.
- Display graphs based on templates.
- Display 3D stick figures. (3D edition)

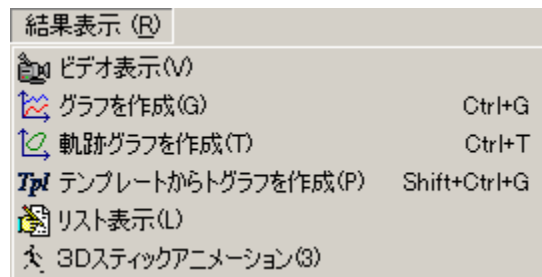


Figure 59 Display Results Menu

5) Specify Point Combinations Menu

As shown in Figure 60, the functions of the “Specify Point Combinations” menu are as follows.

- Combines multiple measurement points and determines the length, area and angle.
- Combines measurement points and determines the point (virtual point) for calculation (2D, 3D)

- Sets the weighted coefficient for each measurement point. Determines the combined center. (2D, 3D)
- Enters models and applies models to measurement point data.

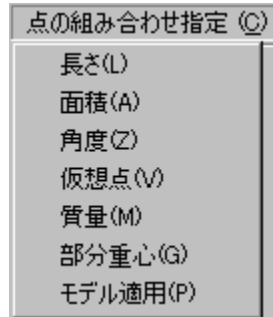


Figure 60 Specify Point Combinations Menu

6) Menu for Changing Coordinates

As shown in Figure 61, the functions of the “Changing Coordinates” menu are as follows.

- Establishes new original coordinates as tracking points.
- Connect two tracking points for a new X axis line segment.
- Change standard time frame and standard displacement frame.
- Correct 2-dimensional calibration.

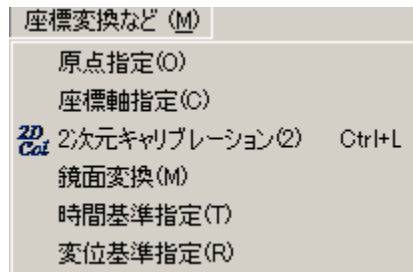
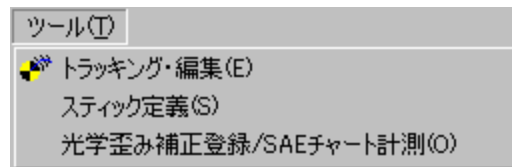


Figure 61 Menu for Changing Coordinates

7) Tool Menu

As shown in Figure 62, the functions of the “Tool” menu are as follows.

- Edit tracking results.
- Create stick figures from combining tracking points.
- Enter data corrected for optical distortion and calculate SAE distortion index.

**Figure 62 Tool Menu**

8) Operating Screen

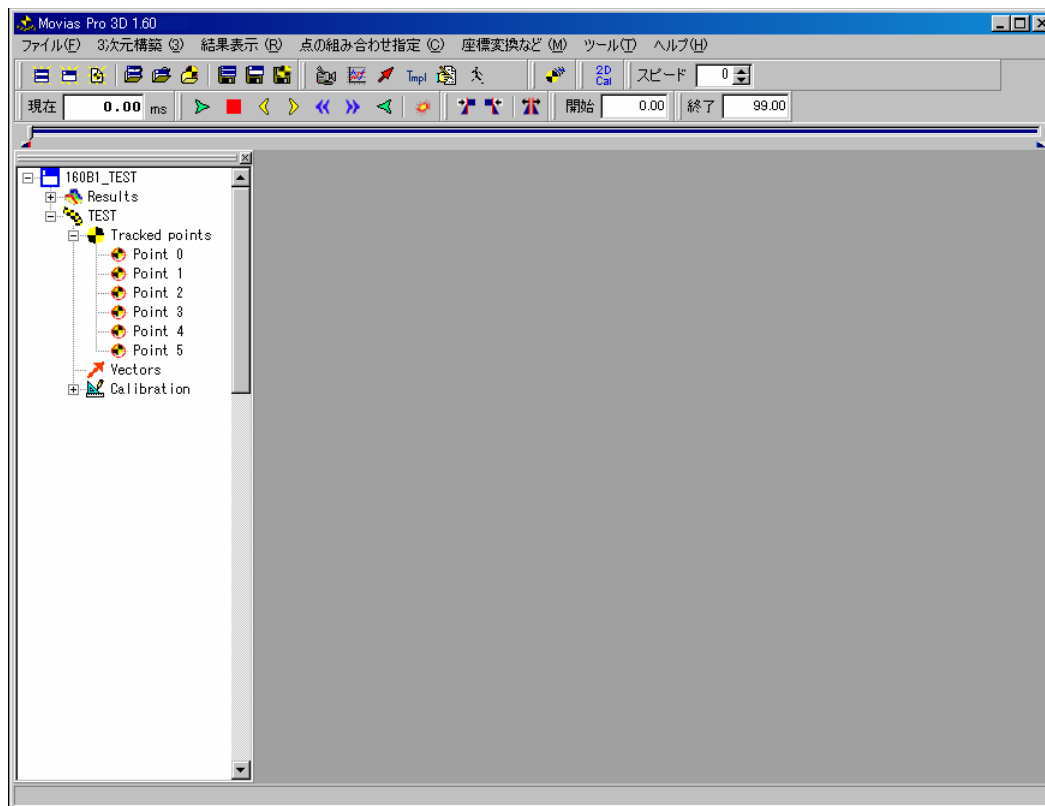


Figure 63 Operating Screen

4.2 File Menu

As shown in Figure 64, the following menu items from start to finish of a new project are available in the “File” menu. The sub-menu is to the right side of each menu item.

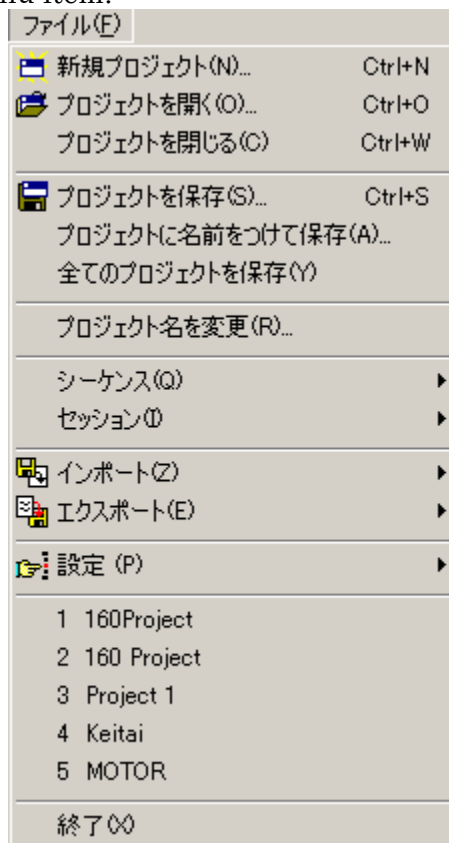


Figure 64 File Menu

4.2.1 New Project

Select the “File-New Project” menu to display the screen in Figure 65 as follows.

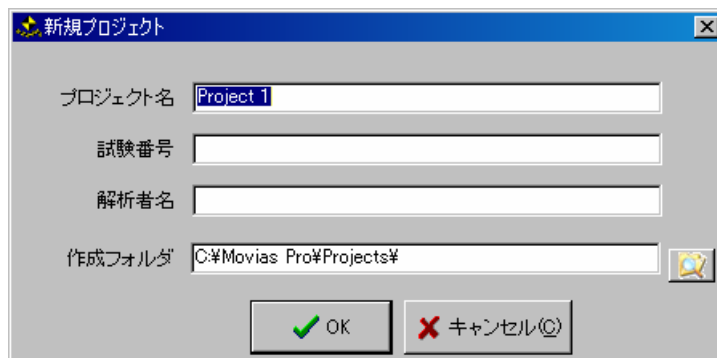


Figure 65 File-New Project

Operation is as follows.

Project name

Items requiring input.

The name given to the project is input here. Since the assigned name is also the named used for saving the projects, use a name identifying details of the project.


- The default is set to be 'Project1'.

- Test number, name of analyzer

If necessary, input the test number, name of analyzer

Input is not necessary. It can be left blank.

- Create folder

Designates the location (folder) where the project is created. The default is the folder where Movias Pro was installed, or specify a folder that is set in the default folder of the "File-Settings" menu. If there is a need to change this, click  to designate the desired folder.

4.2.2 Open Projects

Specify this menu when opening a saved project.

At this point, either double click on the project folder or select by clicking "Open".

(in previous versions, files with extensions of .map were selected from the project folder)

4.2.3 Close Project

Closes selected projects with this menu.

4.2.4 Save Project

Saves projects using this menu. Saving the project also saves the attached sequences.

4.2.5 Save Project As

During editing, a project can be saved by attaching a name. (Figure 66)
This can be used as a backup before changing the project.



Figure 66 Save Project As

Edit projects after saving using the default settings.

To edit a saved project, check “Edit Project Saved Under a Different Name After Saving a Project with a Name” in the “File-Settings-General Settings-Save Settings” menu (→page エラー! ブックマークが定義されていません。).

4.2.6 Save All Projects

Saves all of the currently open projects at one time.

4.2.7 Change Project Name

Changes the project name. (Figure 67)

Enter the new project name and press OK.

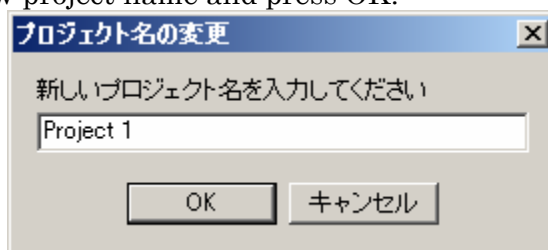


Figure 67 Change Project Name

It may not be possible to change graphs or videos when displayed.

If an error message appears, restart Movias and after accessing the project, try again before performing other operations such as displaying graphs.

4.2.8 Sequences



Figure 68 Sequence Sub-menu

1) New Sequence

Select the “File-Sequence-New Sequence” menu and the screen in Figure 69 will be displayed¹⁷.

¹⁷ Immediately after creating a new project, the new sequence screen is automatically

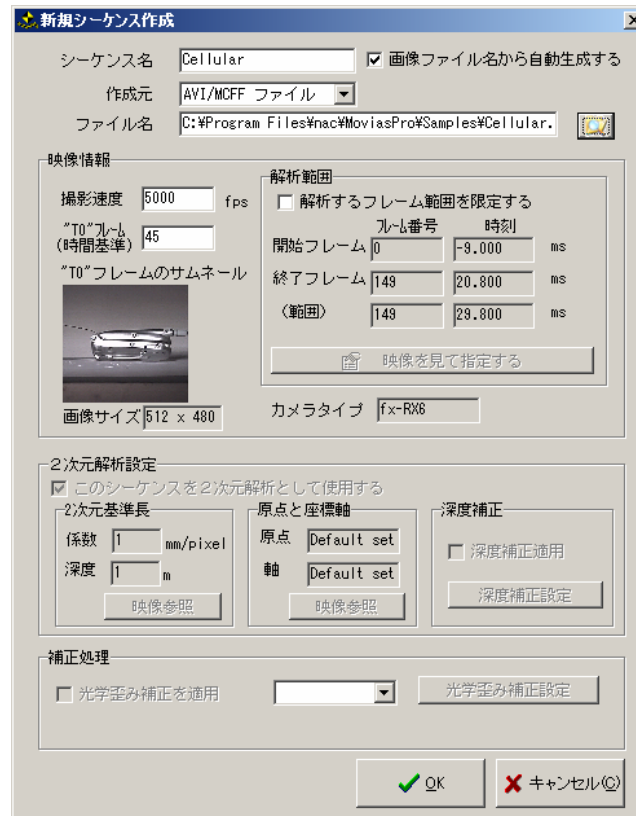



Figure 69 File-New-Sequence

This operation is performed as follows.

- Sequence Name
Items requiring input.
The name given to the sequence is input here. Use a name to easily identify the sequence details.
With defaults, the name of Sequence ¹ is pre-set so check “Automatically Create from Image File Name” to automatically create a name from the image file name.
(Ex: With Cellular.avi, the sequence name is “Cellular”)
- Originator
Select how to create a sequence.
Select from AVI/MCFF File, 2D Results File or 3D Results File.
- File Name
Specify file to create a sequence. Click  to specify a file.
- Image Information
Select an AVI/MCFF file as the originator and specify the file name so the

displayed.

AVI/MCFF file photographic speed, frame number for the T0 frame, and thumbnail image will be displayed.¹⁸

- Scope of Analysis

If analyzing only a section of an AVI/MCFF file, check “Limit the Frame Range to Analyze” and specify the beginning and ending frame numbers of the frame range to analyze. Click “View Image to Specify” to view the beginning/ending frames and specify.

If an AVI/MCFF file was specified as the original data input, it will continue tracking these target marks. If a 2D/3D Results File was specified as the original data input, These files will be read and a new sequence created.

The sequence information set can later be used as a reference for sequence properties.

Refer to 4.9.2 Sequence Right Click Menu (→page 185).

2) Copy Sequences from Other Projects

Use this menu when copying sequences from other projects. First select the project to be copied and then select this menu. Since the screen where the selected sequence to be copied will be displayed, select the sequence to copy.

Press O and the sequence will be copied.
3-dimensional sequences cannot be copied.

4.2.9 Sessions



Figure 70 Session Sub-menu

Sessions allow multiple projects to be opened. Opened projects are stored as a session so multiple projects can be opened at one time.

(Note) Session information is saved as a full path so caution is required when moving projects or copying them to other PCs.

1) Open Session

¹⁸ If the AVI/MCFF file was created with our camera control software fxLink, the photographic speed and frame number of the T0 frame is set automatically. With standard AVI files, since the Movias Pro default value will be displayed, change these values if they vary from actual.

Specify this menu when opening a saved session.

2) Save Session

Saves multiple projects currently open as a session.

4.2.10 Import

1) CSV Graph Data

Use this menu to import graph data that is a CSV format text file. Details of the CSV format text file are found in “3.9 CSV Graph Data in Movias Format (→page 67)”.

2) WaveIn Analog Waveform Data

Use this menu when importing analog waveform data files created in Wave-in¹⁹. After selecting the sequence to import from the tree, use this menu to open the Wave-in analog waveform data file with the extension of .wvb. This accesses the import screen.

Select the following settings, press the import button and the waveform data will be imported with the conditions set.

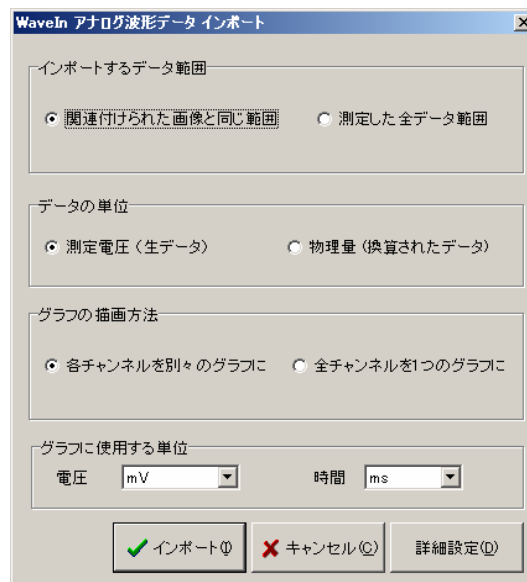


Figure 71 Wave-in Analog Waveform Data Import Screen

2-1) Import Data Range

- The same range as the related image
A time range with the same added sequence image is selected automatically and captured.
- Range of All Measured Data
Access all measured data.

2-2) Data Units

¹⁹ Image•waveform synchronized display software produced by Library Corporation.

- Measured Voltage (Raw Data)
Plot measured voltage.
- Physical Quantity (Converted Data)
Plots calculated physical quantity based on the conversion coefficient set by Wave-in during voltage measurement. Refer to the Wave-in manual produced by Library Corporation.

2-3) Method of Drawing Graphs

Plots data for multiple channels input to separate graphs by channel. (For example, create 3 graphs from measurement data from 3 channels.)

Plots all of the channel data on a single graph.

2-4) Units Used in Graphs

Select the units used for drawing graphs.

Voltage can be in V, mV while time can be in sec, ms.

2-5) Detailed Settings

Detailed settings are required in special cases where the import range has shifted and is not synchronized with the image. In general, use the simple setting screen in Figure 71.

Press the detailed settings button to open the screen shown in Figure 72.

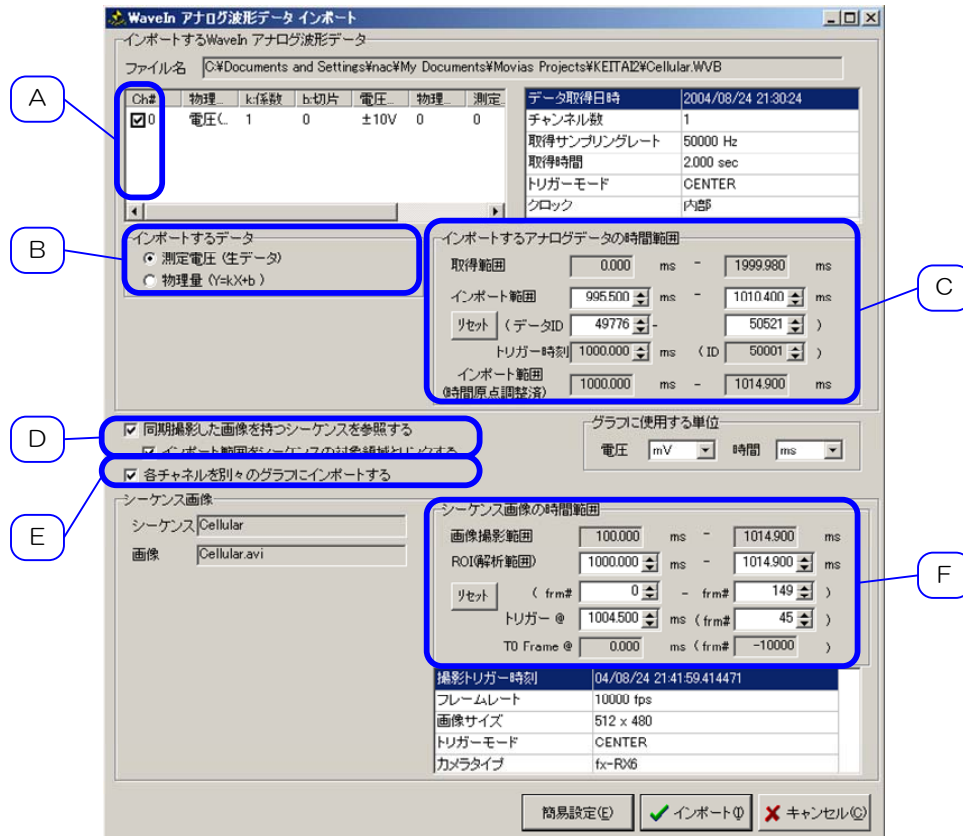


Figure 72 Wave-in Analog Waveform Data Import Screen

- If there is data for multiple channels contained in the analog waveform data file and if a portion of the channel data is not imported, remove the check from these in section A.
- When importing, either select the option in section B to import raw data (voltage data) or to import data converted from the physical quantity.
- If there is data for multiple channels contained in the analog waveform data file and if this is superimposed on a single graph, remove the check from “Import Each Channel from Separate Graphs” in section E.
- If changing the time range for the analog waveform data to be imported, adjust the import range in section C. (Note: The retrieved range (imported range) data ID · trigger time table become the time range with Library waveform input systems. If importing to actual sequences, import with the time range for the import range (adjusted time starting point).)
- If the check to reference the sequence with an image simultaneously photographed in section D is removed, the image time data cannot be referenced.
If checked, reference the time range for the image data to be able to specify the

import range for the waveform data.

Additionally, if “Link the Import Range with the Sequence Region” is checked, the import range can be linked with the image range.

At this point, if the ROI in section F is changed, the import range in section C is linked and moved. Then, the trigger time series will be synchronized with the trigger time series of the waveform input so if the time range retrieved for the image data and waveform data differ, the common space for both can be automatically selected.

- Pressing the simple settings button will return to the simple settings.


4.2.11 Export

1) Batch Output for Excel Graphs

Using this function enables multiple graph data to be batched and output to a single Excel workbook. Single graph data for each Excel worksheet can be output.

Step-1: Display the graph to be exported to Excel on the screen.

Step-2: Either select the “File-Export-Batch Output for Excel Graphs” menu or

press  on the toolbar to display the following “Export Multiple Graphs to Excel” screen. Enter the graph to be output to Excel in the “Output Graphs” list and press OK. The name of the worksheet for each graph output is displayed in the “Worksheet Name” list. In this example, a “Position” graph can be output to the Excel worksheet “Data1”, a “Velocity” graph to “Data2”, or an “Acceleration” graph to “Data3”. Graph titles are displayed on the “Output Graphs” list.

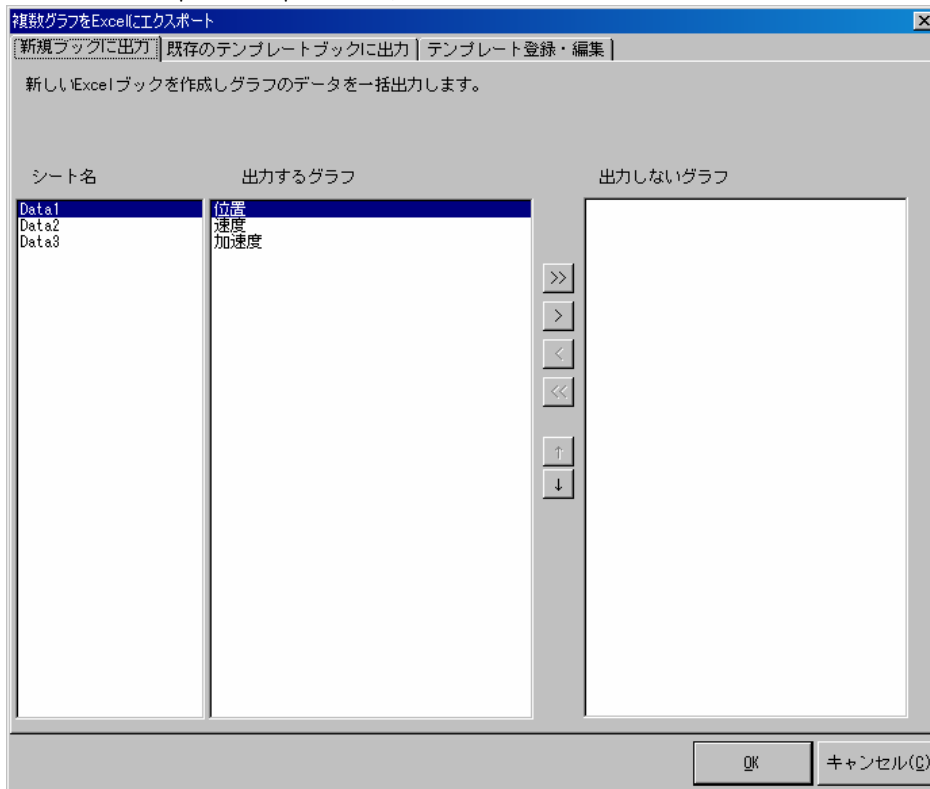


Figure 73 Batch Output for Graphs Screen

Step-3: Press OK to display the save dialogue box for the Excel file output and add a name to save.

Step-4: Start Excel to automatically open the Excel file specified in Step-3.

2) Output Graph to Excel Template

For example, use the coordinate data exported from Movias to perform user specific calculations in Excel. If drawing the graph, it is difficult to edit the Excel worksheet exported from Movias each time. In this case, enter the Excel worksheet where the user specific calculations and graphs have already been created into an “Excel Template” so data can be exported into that template for each analysis.

2-1) Example of the Excel Template Output Function

This is a description of a simple example.

Calculations are conducted on Excel for the Y coordinate data of a 4-quarter mark at the top right (*1) of a sample cell phone drop image by separate users (the Y coordinate data is doubled for an average value), with the graph displayed as follows.

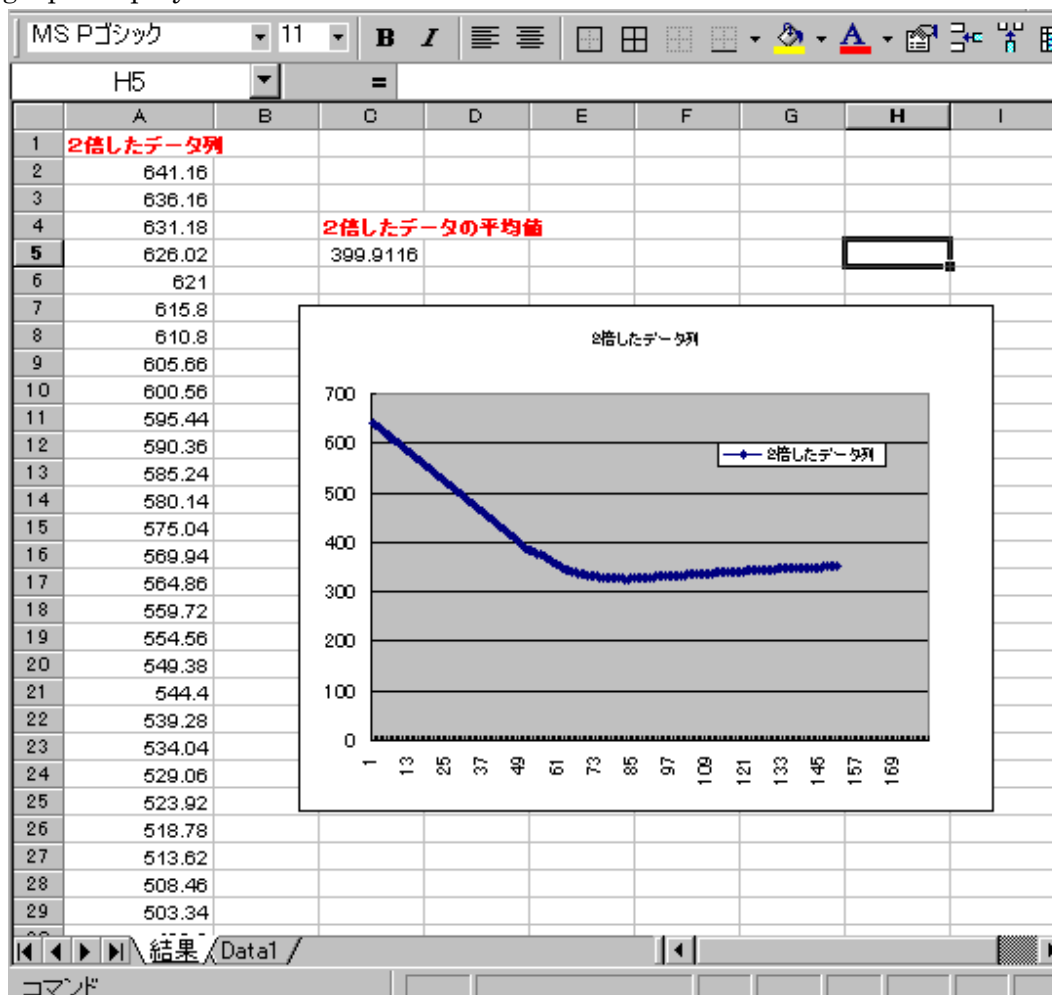


Figure 74 Example of Excel Template


(*1)The sample image of the cell drop test is found in the Samples folder of the Movias Install folder.

Ex.) C:\ProgramFiles\Nac\MoviasPro\Samples\Cellular.avi

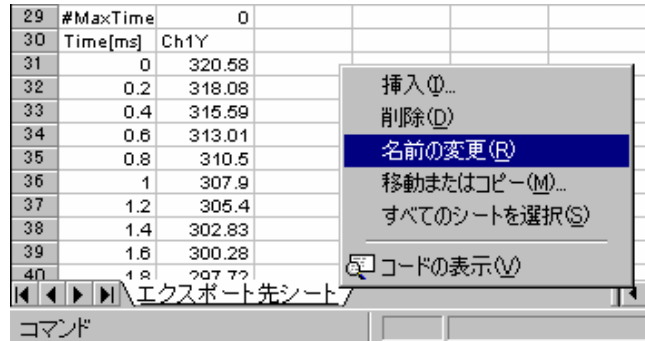
Step-1: (Create Excel Template)

Step-1: The 4-quarter marks on the top right of the cell phone drop image are tracked with Movias.

Step-2: The Y positions of the tracked points are graphed.

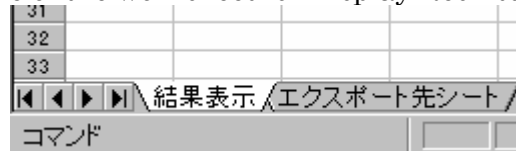
Step-3: Press “Export to Excel”  on the graph to export the graph data to Excel.

Step-4: For ease of use, change the name of the worksheet exported to “Exported Worksheet”.



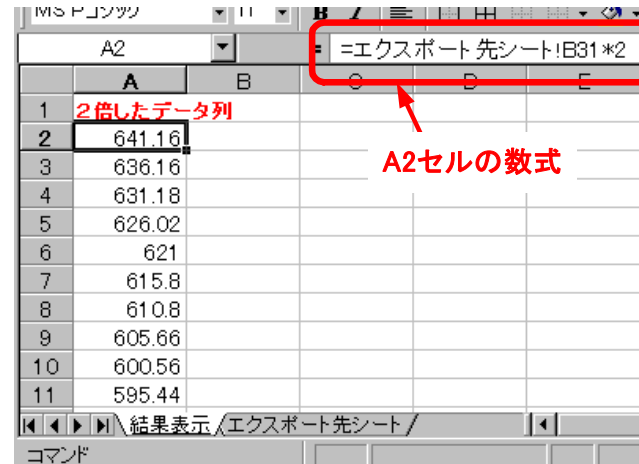
Step-5: Insert the user specific calculations and graphs into a new worksheet for display.

Here, the name of the worksheet is “Display Results”.

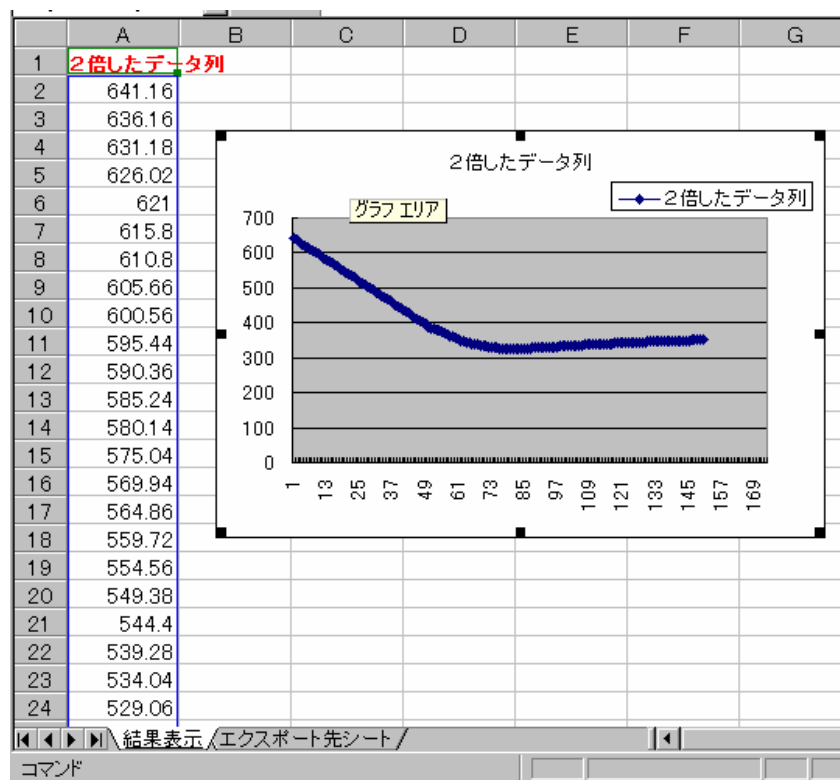


Step-6: The Y coordinate data in “Exported Worksheet” is doubled to create cell range [A2:A151] in the “Display Results” worksheet. In this case, input “=exported worksheet !B31*2” into cell A2 and auto-fill [A2:A151].

Write “column with doubled data” for the comments in cell A1 using the color red.



Step-7: The column of the doubled data is graphed. Select column A to be graphed.




- Step-8: The average value for the column with the doubled data is output. Input the formula for the average of column A “=AVERAGE(A:A)” into cell C4. Write “average value of doubled data” for the comments in cell C3 using the color red.



- Step-9: Save this Excel workbook in the desired location. Here, it is saved as “SampleTemplate.xls”.

<Excel Template Entry・Edit>

Step-10: Select “File-Export-Output Graph to Excel Template” on the menu or press  on the toolbar to display the “Export Multiple Graphs to Excel” screen and select the “Template Entry・Edit” tab.

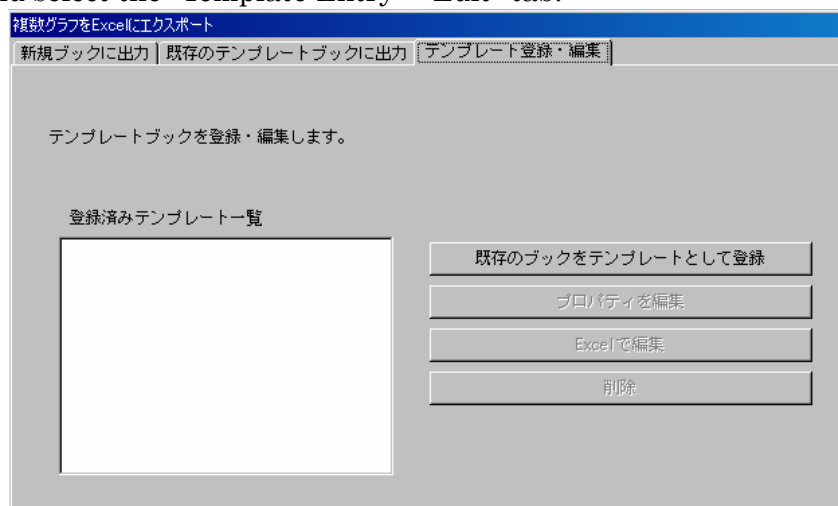


Figure 75 Template Entry Screen

Step-11: Press “Enter an Existing Workbook as the Template” to display the Select File dialogue box and select the template. Here “SampleTemplate.xls” from Step-9: is selected.

Step-12: The following “Properties of Template Workbook” dialogue box will appear for a name to be given to the template subsequently created. Here it is “Doubled Y Coordinate Template”. If necessary, comments can be entered.

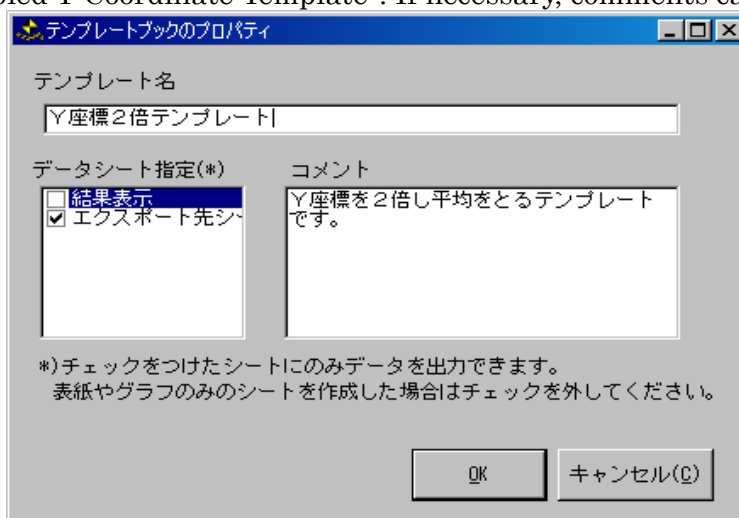


Figure 76 Properties of Template Workbook Screen

Step-13: A listing of Excel templates is displayed in the “Specify Data Worksheet” list. Remove the checks from everything but the worksheet to be exported by Movias (in this case “Exported Worksheet”). Press OK to finish entering templates.

Step-14: Verify that the entered template is on the list of entered templates.

If editing the name or comments on the template press “Edit Properties”. If referencing/editing the Excel file in the template itself, press “Edit in Excel” and if deleting an entered templated, press “Delete”.

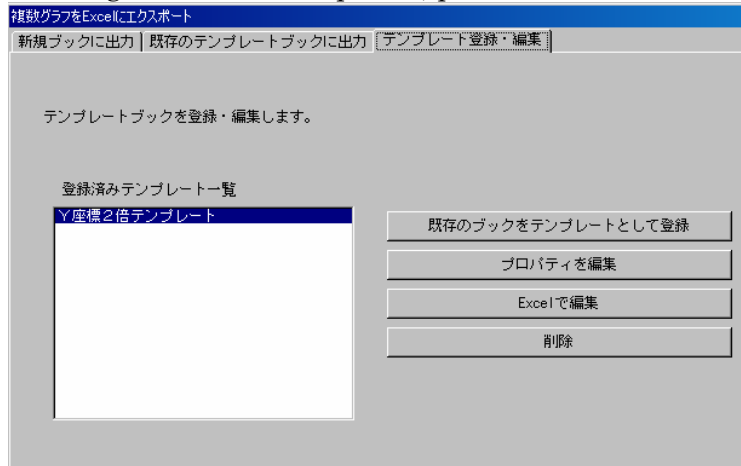



Figure 77 Edit Template Screen

<Output Graph to Existing Excel Template>

Step-15: Track new points different from those in Step-1. Here, the 4-quarter marks at the very left side of the same cell phone drop sample image are tracked.

Step-16: The tracked points are graphed. Here, the X positions of the tracked points are graphed.

Step-17: Select “File-Export-Output Graph to Excel Template” on the menu or press  on the toolbar and the “Output to Existing Template Workbooks” tab on the “Export Multiple Graphs to Excel” screen will open.

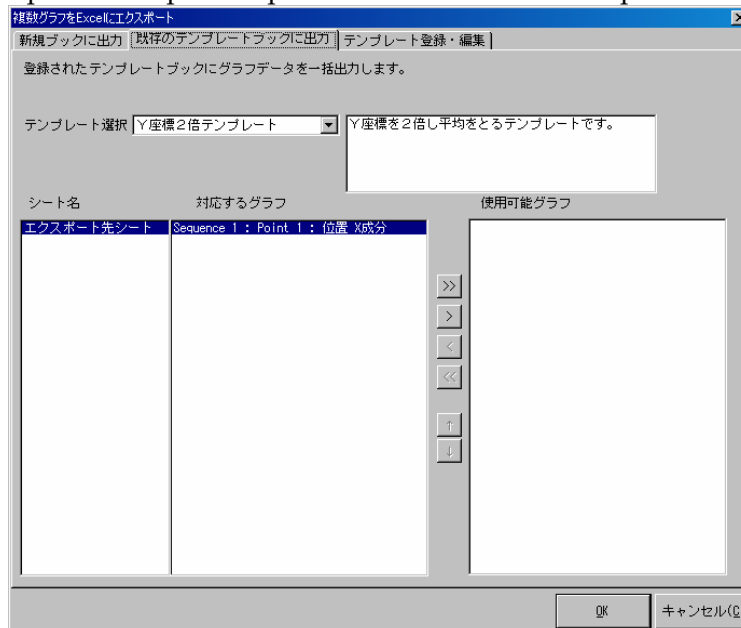


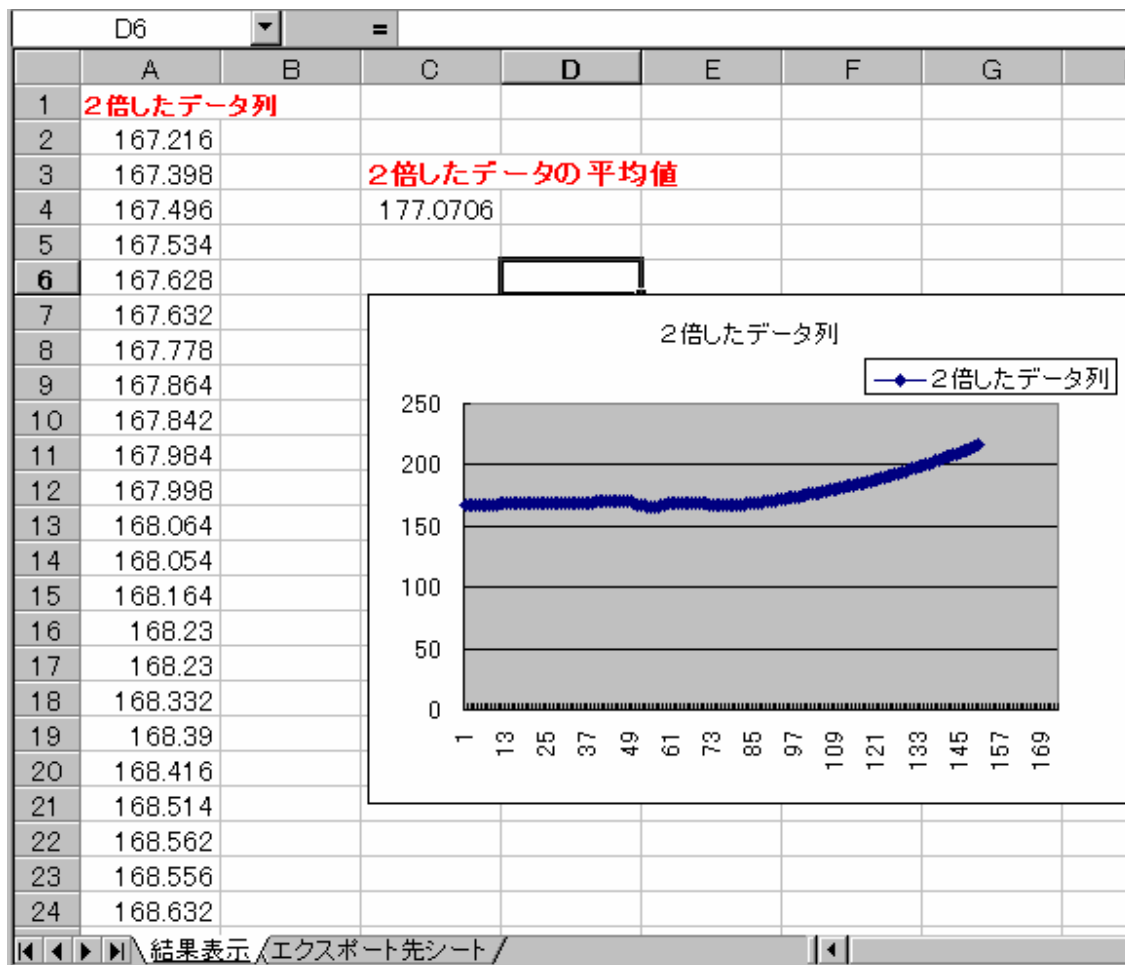
Figure 78 Output to Existing Template Workbooks Screen

Step-18: Select the template to be exported from the “Select Template” combination box. Here, the previously created “Doubled Y Coordinate Template” is

selected. Select the template to display a listing of worksheet names for export and a listing of graphs displayed on the screen.

Step-19: Add the graph corresponding to the worksheet name to be output to the "Graphs" list and press OK. In this case, the graph for the position of X coordinates drawn previously in "Exported Worksheet" is output.

Step-20: A dialogue box specifying the location where the Excel workbook is saved will be displayed so save by adding the desired name and the corresponding Excel file will start automatically. Verify the average of the doubled data for the X coordinates of the new tracked points and the graph.



2-2) For More Precision with Excel

Use the Excel VBA macro function for more precision with Excel. After Movias exports data to an Excel template, this starts MoviasStart() so it should be used for automatic processing after exporting.

3) Text Formatted Coordinate Data

With this menu, raw coordinate data for tracking points is output to text formatted files.

Click on sequence in the data tree to select this menu and save the X, Y coordinates for all of the tracking point in the sequence to a hard disk as text files. The units for these X, Y coordinates are pixels in AVI images. The starting point for the coordinates is the top left of the screen.

Next, Figure 79 shows an example of a text file. The data is separated by commas to make it easy to access in Excel.

Here, starting with the row # Pix Size at Cal Depth, the numerals are coordinates in pixels that have been converted to mm units.

Fig

```
#
# MOVIAS PRO
#
# file name : D:\Work\Export_ASCII.csv
# date : 02/08/20
# Sequence Name : MIRA BLUE
# Sequence Source File : S0099v3.avi
# Point : 0 = Point 0
# Point : 1 = Point 1
# Pix Size at Cal Depth , 6.23638
# F-seq, Point, time, X, Y, Z
0,0,0,427.334299033567,230.859412522263,10
1,0,0.001,424.892176130767,231.547336800701,10
2,0,0.002,421.854097573042,232.301120242838,10
3,0,0.003,418.85780280482,231.852017877732,10
4,0,0.004,415.898853921539,231.936674457328,10
5,0,0.005,413.164865734215,232.025465487598,10
0,1,0,480.336618284009,230.867379647052,10
1,1,0.001,477.755161396579,231.171027661172,10
2,1,0.002,474.388188303128,232.303173380077,10
3,1,0.003,472.028496109502,231.590372797911,10
4,1,0.004,468.94655237997,231.811649935502,10
5,1,0.005,466.59564176589,231.902456552889,10
#
```

4.2.12 Settings

1) General Settings

All of the default settings relating to Movias Pro can be decided in “Settings-General Settings”.

1-1) Default Settings

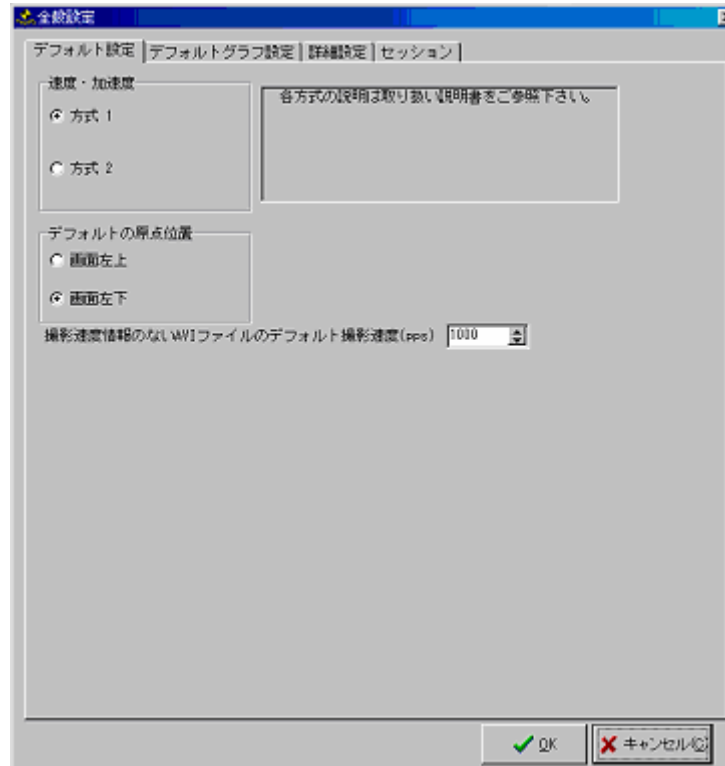


Figure 80 General Settings-Default Settings

- Velocity • Acceleration

This is where the defaults for the method of calculating velocity and acceleration are determined.

Formula 1: Use the data for the surrounding frames to calculate the velocity/acceleration for a given frame. For example, the velocity for the X direction VX for frame number i is calculated with the formula

$$VX_i = \frac{X_{i+1} - X_{i-1}}{T_{i+1} - T_{i-1}}.$$

Formula 2: Use the data for this frame and the next frame to calculate the velocity/acceleration for a given frame. For example, the velocity for the X direction VX for frame number i is calculated with the formula

$$VX_i = \frac{X_{i+1} - X_i}{T_{i+1} - T_i}.$$

- Default for Starting Point

Either set the default starting point at the top left or the bottom left of the screen.

- Default Photographic Speed

If analyzing images without photographic speed information, the photographic speed set here will be displayed as the default. Set the photographic speed with the highest speed used.

1-2) Default Graph Settings

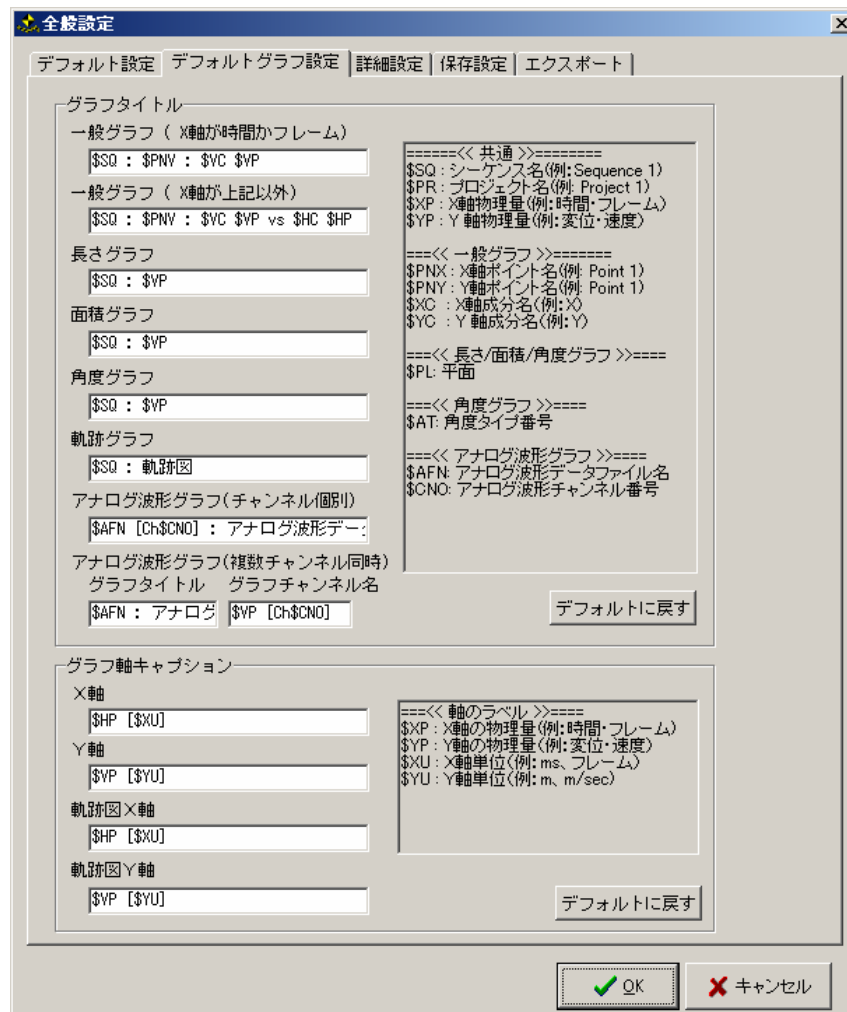


Figure 81 General Settings-Default Graph Settings

This is where the default for the characters showing the graph title and axis captions are determined. When characters starting with \$ are graphed, the

actual data name and sequence name are changed. The conversion for this is shown on the right side of the screen.

1-3) Detailed Settings

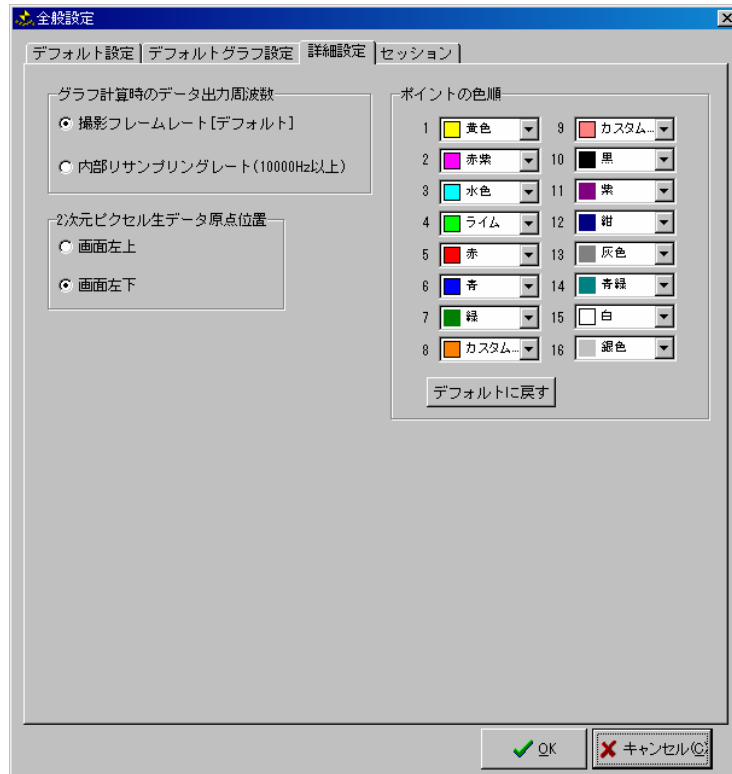


Figure 82 General Settings—Detailed Settings

- Data Output Frequency

This is where the sampling rate is selected for converting data shown on a graph. Text data can also be output with this sampling rate.

The default sampling rate matches the photographic frame rate.

The internal sampling rate is determined as follows.

- If the photographic frame rate is less than 8000fps,

the photographic frame rate is doubled so the minimum value is greater than 10000fps.

For example, it is 10000fps if the photographic frame rate is 500, 1000 or 5000fps.

It is 12000fps if the photographic frame rate is 4000fps.

It is 14000fps if the photographic frame rate is 7000fps.

If the photographic frame rate is greater than 8000fps, the photographic frame rate is used.

- Raw Data for Starting Point Position

Determines the starting position when raw data is output to a text file.

- Color Sequence for Point

Determines the color of the data line when graphs are output. If the number of points exceeds 16, it repeats from the first color.

1-4) Save Settings

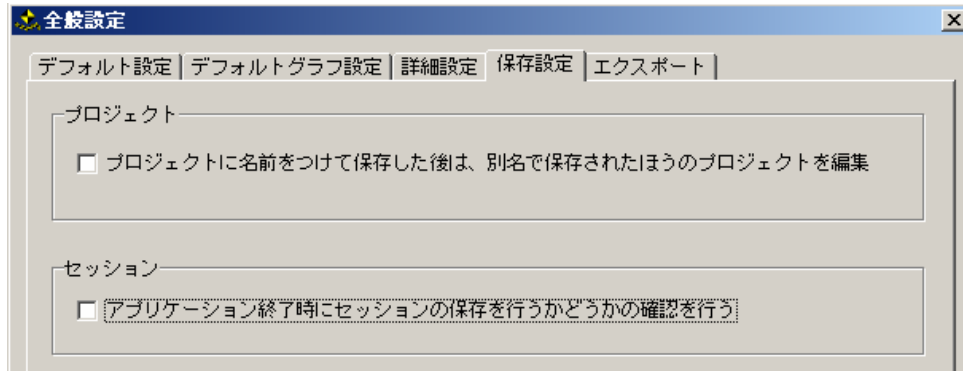


Figure 83 General Settings—Save Settings

- * Project

Check “Edit Project Saved under a Different Name after Saving a Project with a Name” to open a project saved under a different name and then edit it.

- * Session

Check “Verify if a Session was Saved when an Application was Ended” to determine if a session was saved when MoviasPro was ended.

1-5) Export

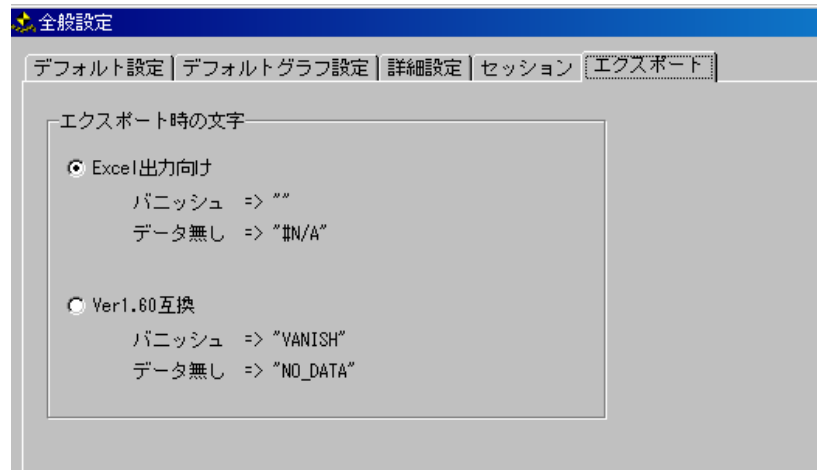


Figure 84 General Settings — Export

Sets the characters for Excel/CSV output for graphs. Refer to “3.9 CSV Graph Data in Movias Format (→page 67” for the output format.

2) Default Folder Settings

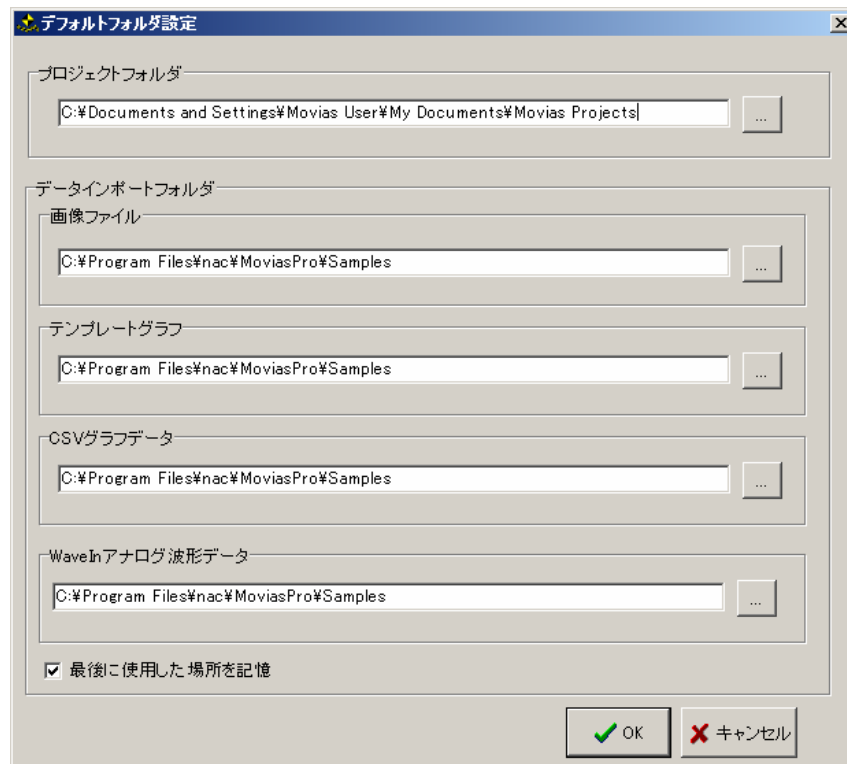


Figure 85 Settings— Default Folder Settings

Here, the default for the operating folder is set.

- **Project Folder**
This is a folder where projects are saved. The default is the “My Documents\Movias Projects” folder.
- **Image File Import Folder**
This is the folder where the AVI/MCFF files are saved.
- **Template Graph Settings Import Folder**
This is the folder where the graph templates are saved.
- **CSV Graph Data Import Folder**
This is the folder where the CSV formatted text files imported as graphs are saved.
- **WaveIn Analog Waveform Import Folder**
This is the folder where the Wave-in analog waveform files are saved.
- Check “Save where Last Used” to save the file in the folder that was last loaded.

3) Default Settings to Display Results

This is divided into display video and graphs.


3-1) Display Video

The default format for the video display is determined here. (Figure 86)



Figure 86 Display Video —Default Settings

The three items at the top determine the color, the shape and the size of the point.

Click  to set the color.

As shown in Figure 87, the two point shapes include a cross and a circle.



Figure 87 Point Shape Cross and Circle

Sets the size of the point.

Sets the line width.

3-2) Graph

Sets

- Verification if the results are saved when the graph is closed
- Verification if the graph is entered in the results
- The default cursor for the graph created for the graph output.

エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。エラー!
参照元が見つかりません。 explains the changes to the standard styles.

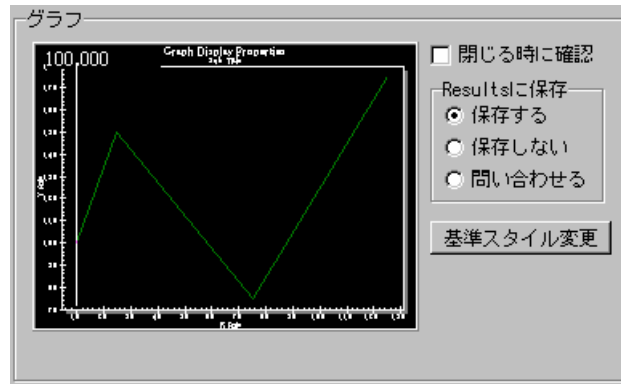


Figure 88 Graph-Default Settings

- 4) User Settings for the Tracking • Editing Screen
Sets the operations for tracking. (Figure 89)

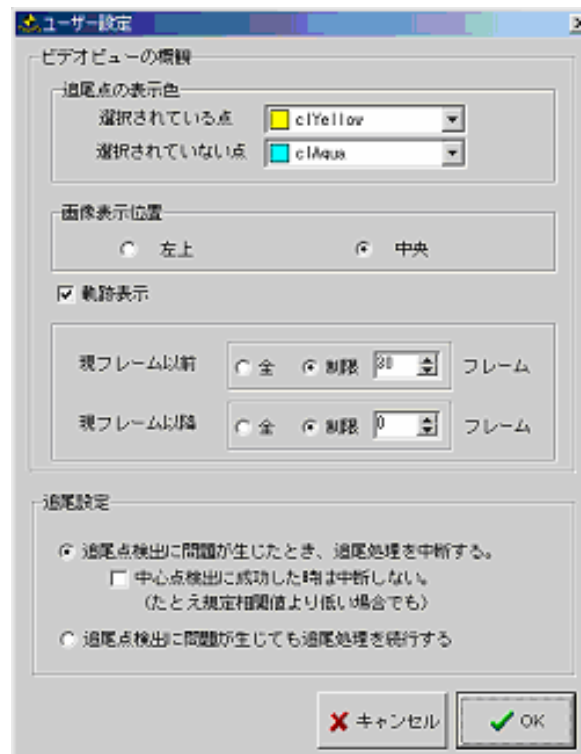


Figure 89 Settings- User Settings for Tracking•Editing Screen

4-1) Overview of View Video

The display color for tracking points selected as well as other tracking points and the tracking trajectory display is set in the tracking window.

* Display Color of Tracking Points

Sets the display color of tracking points.

Points selected can be set separately from points not selected.

* Image Display Position

When the image size is within the display area of the video view, the display position can be set to the top left or the center of the screen.

*** Trajectory Display**

Trajectory display on the tracking screen can be turned OFF by removing the check mark.

*** Before/After the Current Frame**

Selects how many frames to display before/after the currently displayed frame.

Limiting the length demonstrates the difference in the velocity according to the difference in trajectory length.

This setting is also used for trajectory frame drawing settings in the “Display Results—エラー! 参照元が見つかりません。” menu (→page エラー! ブックマークが定義されていません。).

4-2) Tracking Settings

This can be set to interrupt the detection process when a tracking point detection error occurs.

Select “Interrupt the Tracking Process If a Tracking Point Detection Problem Occurs” and if the correlation coefficient is less than the lower limit established or if there is an error in center point detection, the user is informed and manual correction is required.

If “Do Not Interrupt If Center Point Detection is Successful” is checked and the center point detection is successful even if the correlation coefficient is less than the lower limit established, it is not interrupted.

If “Continue Tracking Even If a Tracking Point Detection Problem Occurs” is selected, automatic tracking in the designated range continues until the end without advising the user even if there is a tracking point detection problem during tracking.

(If this option is selected and a tracking point is out of place, since a completely different point will be tracked, in most cases it will need to be corrected later so the amount of work increases.)

5) Reset All User Settings to the Initial Values

Resets all user settings to the initial values.

Items reset with this function include

- User settings set in “File-Settings-All Settings” menu
- Default settings parameters used for tracking

Other user settings (values set at the end of each type)

4.3 3-dimensional Structure Menu

4.3.1 Calibration Information Input

1) Operation

Input control point data with the menu “3-dimensional Structure-Calibration Information Input”.

Select this menu to display the screen shown in Figure 90.

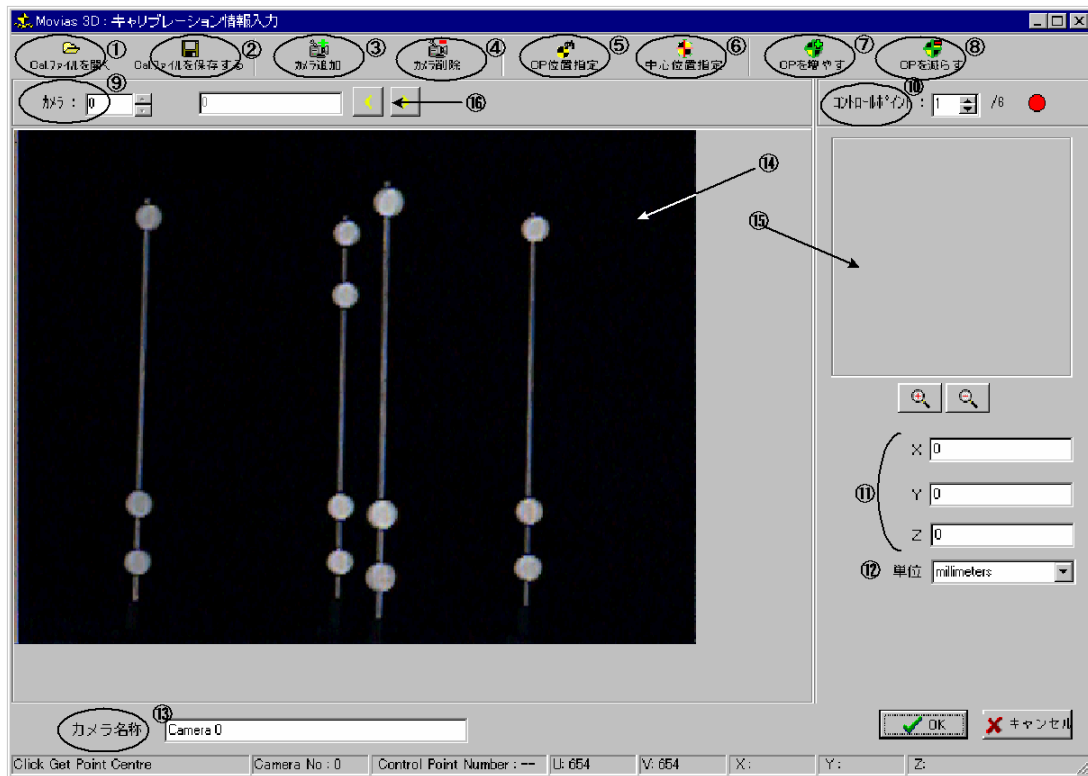









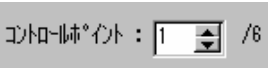


Figure 90 Control Point Data Input Screen

Functions

Button	Operation
①  Cal.ファイルを開く	Opens previously input control point data saved on the disk. Can be used with current projects.
②  Cal.ファイルを保存する	Saves input control point data to the disk for use in other projects.
③  カメラ追加	Sets the number of cameras used for input. Each time this is clicked, the number of cameras increases by one. The minimum number is 2.
④  カメラ削除	Deletes the last camera set with 'Add Camera'.

⑤		Click on the control point position in the image.
⑥		Verifies the center position setting for the control points.
⑦		Determines the number of control points used. Increases by one each time this is clicked. (Minimum of 6)
⑧		Decreases the control points used.
⑨		Changes the cameras.
⑩		Changes the control points.
⑪	X, Y, Z	<p>Inputs the actual 3-dimensional coordinate values for the control points.</p> <p>Please use coordinate values from a coordinate system where the front of the subject is the X axis (movement direction), the left side is the Z axis and the top (ceiling direction) is the Y axis.</p>

2) Specific Steps

Specific steps for control point data input are as follows.

- 1) Click “Increase CP”(⑦) several times to adjust the number of control points used.
- 2) Load the camera image file (Tiff file or AVI file) used with “Add Camera”(③) while simultaneously specifying the camera name.
Repeat for the number of cameras.
- 3) Use the camera selection section (⑨) for the first camera (#0).
- 4) Use the control point selection section (⑩) for the first point (#1).
- 5) Click “Specify CP Position”(⑤).
- 6) Click on the position of the first control point (#1) on the image(⑭).
- 7) Use the mouse to right click on the center of the point in the zoom window(⑮),
At this point, changes in the image display position can be made by dragging with the left mouse button.
- 8) Click “Specify Center Position” (⑥).
- 9) Use the control point selection section (⑩) for the following points.
- 10) Repeat from (5) until the last control point.
If all of the control points are not in a single frame when the image file is an AVI file, use the play frame button in ⑯ to display the frames capturing the specified control points.
- 11) If the center of the control point is incorrect, use the control point selection section (⑩) to select that point and repeat steps (6) to (8).
- 12) Use the camera selection section (⑨) to proceed to the next camera.

- The image for this camera will be automatically displayed.
- 13) Repeat from step 4) and specify the center of the control points for all of the cameras.
At this point, the procedure for specifying control points for all of the cameras is identical.
 - 14) Once the centers have been specified, input the actual 3-dimensional coordinates for all of the control points. Use the control point selection section (⑩) for input to replace the points. At this point, it doesn't matter which camera is selected.
 - 15) Click "OK" upon completion.

4.3.2 3-dimensional Data Structure

Specify combinations of multiple 2D sequences and control point data using the "3-dimensional Structure-3-dimensional Data Structure" menu to create 3D sequences.

Specify this menu and the screen in Figure 91 will be displayed.

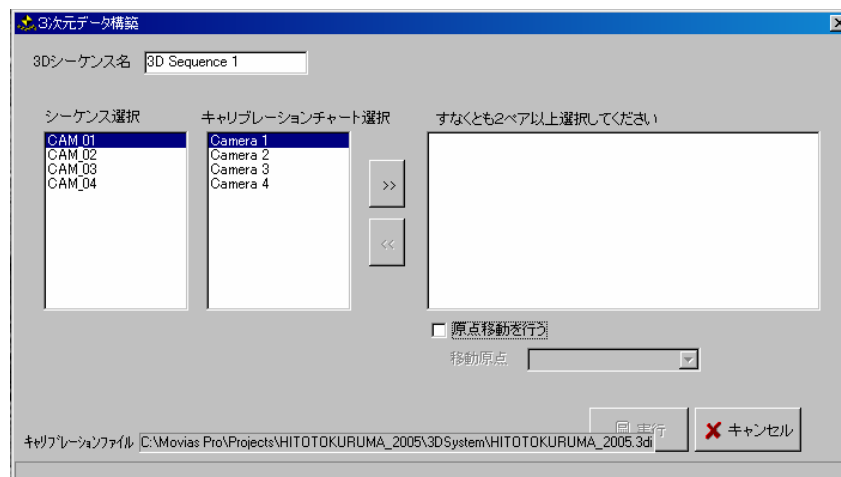


Figure 91 3-dimensional Data Structure

Specify combinations of 2D sequences and control point data in this screen. Select sequences and control point data for the same camera on the list to the left and then click the >> button. Perform this for multiple sequences. If there is an error, select the incorrect item on the list to the right, click the >> button to delete and then make the corrections.

If one of the measurement points is the starting point for the coordinates, select the 2-dimensional sequences and calibration data and then check "Move Starting Point". Then, select the point to be the starting point from the "Move Starting Point" list.

4.4 Display Results Menu


Next is a description of the menu to display results.

The menu to display results is accessed by clicking on the toolbar button to display results from Figure 92, as follows.



Figure 92 Display Results Toolbar

4.4.1 Display Video

The toolbar button corresponding to the “Display Results – Display Video” menu is .

With this menu, the tracking results (a trajectory or stick figure) are shown on the image as found in Figure 93.

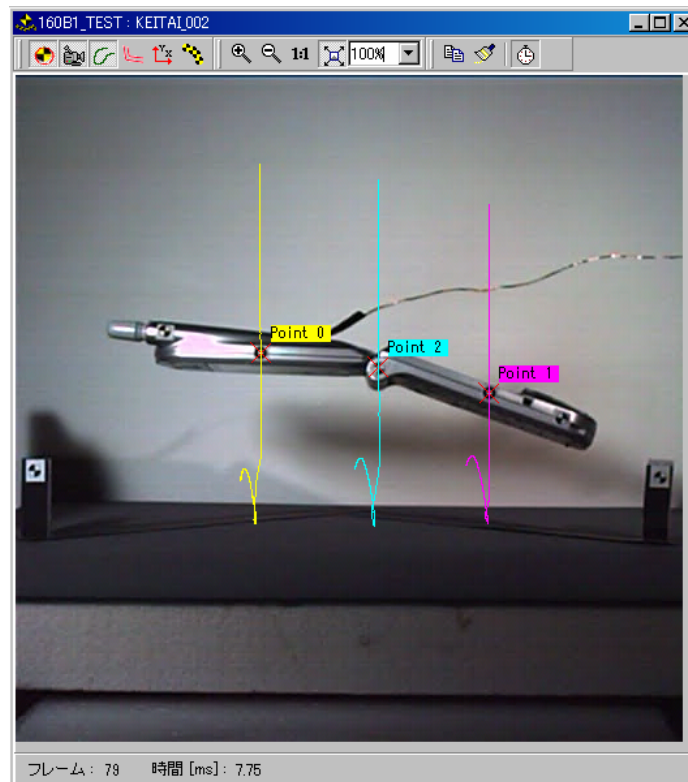


Figure 93 Example of Display Video

The functions of the buttons at the top of the screen are as follows.



: Turns ON/OFF each display.



: Turns ON/OFF the display of the point name, such as Point 0.



: Turns ON/OFF the video image display.



: Turns ON/OFF the trajectory figure display. (Settings for the number of frames displayed on the trajectory are made in “[4.2.124](#) User Settings for the Tracking • Editing Screen (→page 109)”.)



: Turns ON/OFF the stick figure display (if the stick is defined).



: Turns ON/OFF display of the coordinate axis (if coordinate axis is given).



: Turns ON/OFF display of the O mark showing the tracking point.



: Displays enlarge/reduce of the image.



: Enlarges/reduces the display each time the button is clicked.



: Displays pixel rate.



: Adjusts the size with the window.



: Displays optional sizing. Enter the number and press Enter.



: Other settings



: Copies video display to the clipboard.



: Sets the background color when the image display is OFF.

Changing the background color makes the trajectory figures and point displays easier to see.



: Press this button when displaying multiple video display sequences to set the time interval for the image to the standard for image playback.

4.4.2 Creating Graphs

1) Standard Operations

The toolbar corresponding to the “Display Results – Create Graphs” menu is



First, select the sequence containing the tracking points to be output as a graph by clicking on the data tree. Then click on the graph menu. The screen is as shown in Figure 94.

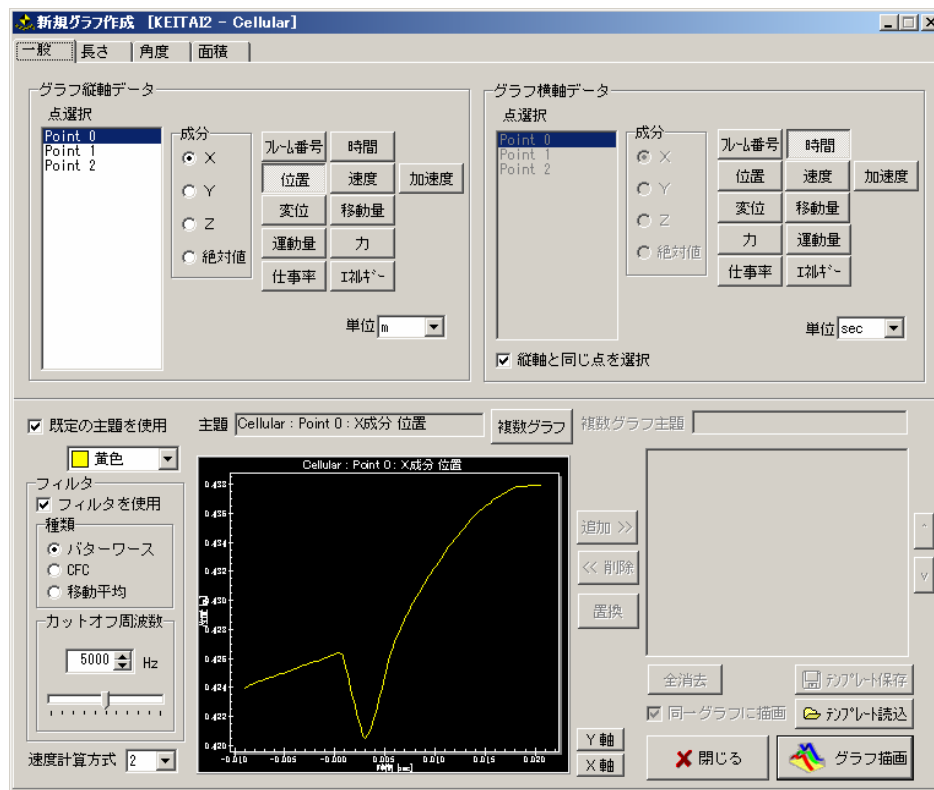


Figure 94 Display Results – Create New Graph

Select the data to be graphed on the top half of this screen. Specify the data combinations relating to the horizontal and vertical axis.

Enter the data combinations on the bottom half of the screen and specify the applications for the smoothing filter to eliminate noise.

On the following page, references are noted for each part of the graph setting screen. Then, specific examples of the operating procedures are given.

Tabs such as “length, angle, area” appear on the upper left of the screen. The descriptions are found on the “Specifying Point Combinations” menu.

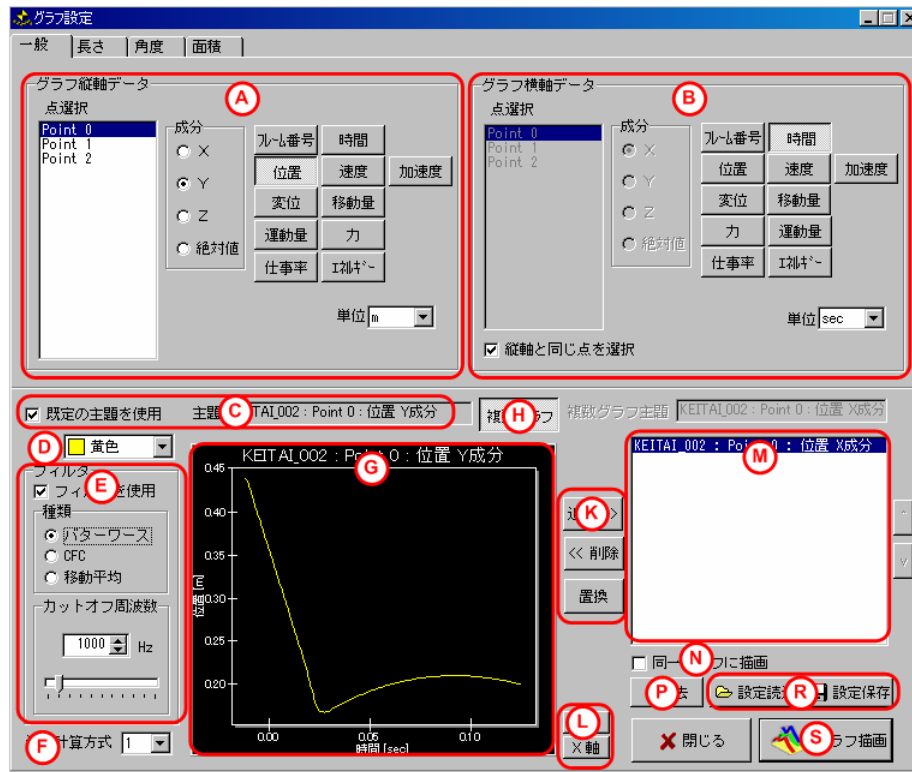


Figure 95 Explanatory Diagram for Specific Operations on the Graph Settings Screen

1-1) Section A: Specifying Data for the Vertical Axis

Determine data related to the vertical axis.

Items determined include the following four types.

- Select tracking points called Point 0, Point 1
- Data differentiated by position, displacement and velocity
- X, Y, Z and absolute value data
- m and mm units

1-2) Section B: Specifying Data for the Horizontal Axis

Set data related to the horizontal axis. Items set are identical to those described in A.

If the tracking point data for the horizontal axis differs from the vertical axis, remove the checkmark from “select points identical to those on the vertical axis”.

1-3) Section C: Changing the Subject of the Graph

Use this section to change the subject of the graph (main title).

First, clear the checkmark from “use existing subject”. Next, change the existing subject shown in “subject”. With multiple graphs

(described later in Section H), change to “multiple graph subjects” on the right side.

1-4) Section D: Change the Color of the Data Lines

The color of the graph data²⁰ can be changed from the default value.

1-5) Section E: Smoothing

This section is used to perform smoothing.

First, check “use filter”. Then, select from the filter types of Vaatwasser, CFC²¹ and moving average. Then set the parameters corresponding to each type.

As shown in Figure 95, Vaatwasser designates the cutoff frequency.

As shown in Figure 96, CFC selects the frequency class from 1000, 600, 180 and 60. The moving average designates the type (3 point average, 5 point average) and the relevant count.

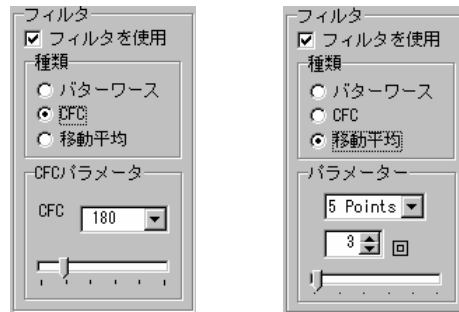


Figure 96 Setting CFC Parameters (at left) and Moving Average Parameters

1-6) Section F: Calculating Velocity and Acceleration

Select the method of calculating velocity and acceleration.

Refer to エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。のエラー! 参照元が見つかりません。エラー! 参照元が見つかりません。 for the calculation method.

1-7) Section G: Graph Preview

This displays a graph preview with the contents set. Single data lines are previewed even if there are multiple graphs (described later in H).

²⁰ Data lines are determined according to the default colors for each point. With a single graph of multiple data points (ie: X and Y coordinates), these are all the same color, making it hard to decipher. In this case, it is useful to modify the colors.

The color of the data lines can be changed after creating the graphs.

²¹ CFC are based on J211-1 of the SAE standards.

1-8) Section H: Multiple Graphs

Click and hold this button to create multiple graphs. With multiple graphs, two or more data lines are drawn on a single graph.

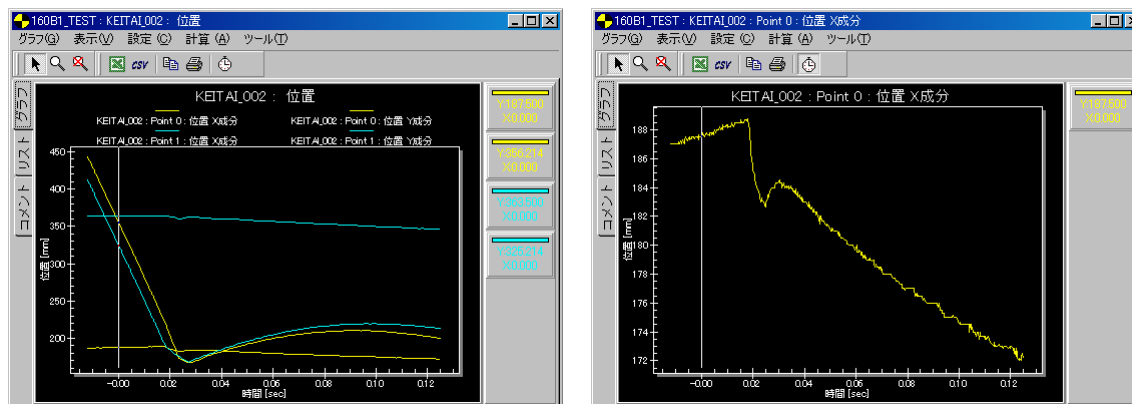


Figure 97 Examples of Multiple (Left) and Single Data Graphs

1-9) Section K: Combined Entry

These three buttons are effective when clicking the multiple graph button in H. If creating multiple graphs, these combinations are entered in M after the data combinations relating to the vertical/horizontal axis have been designated. This performs the multiple data combinations desired. Click on the “Add” button when entering data combinations. Click on the “Delete” button when deleting combinations entered. Click on the “Replace” button to switch the entered combinations with the currently designated combinations.

1-10) Section L: Changing the Scale of the Graph

This changes the minimum/maximum value of the Y axis (vertical)/X axis (horizontal) scale of the graph, and changes the axis label (title).



Figure 98 X Axis/Y Axis Settings

1-11) Section M: Summary of Data Combinations

This section displays a summary of the data combinations added with the Add button in section K. Select data combinations for deleting and replacing by clicking with the mouse to delete or replace in section K.

1-12) Section N: Method of Displaying Multiple Graphs

Remove the check from “Draw on the Same Graph” to create individual graphs with independent data combinations on multiple graphs.

1-13) Section P: Delete Combinations

Click on the “Delete All” button to delete all of the data combinations added and displayed in section M.

1-14) Section R: Save/Load Settings

The summary of data combinations shown in section M is saved on the hard drive with the “Save Settings” button (graph template file)

The summary of combinations stored can be restored to section M using “Load Settings”. This function enables simple creation of graphs combining multiple sequences.

(Point names are used for specifying point combinations. Point names with some meaning aid in the creation of graph templates.)

A settings files with these saved in it (graph template) Graph (→page 149) can also be created.

1-15) Section S: Drawing Graphs


After specifying the data combinations relating to the vertical/horizontal axis and entering these combinations in section M for multiple graphs, the graph is drawn once “Draw Graph” is clicked.

2) Examples of the Graph Creation Process

Next are specific examples of creating graphs. In this generic example, the titles and color of the data lines are changed accordingly, and smoothing processes are specified.

2-1) Example of Graph (Single Data) Creation Process

This is an example of the process to create a graph of the Point 2 Y displacement over time (horizontal axis).

Step-1: First, select the desired sequence for graph creation from the data tree on the left side by clicking on the mouse. Next, specify with the “Display Results – Graph” menu or the graph tool . This opens the graph settings screen (Figure 99).

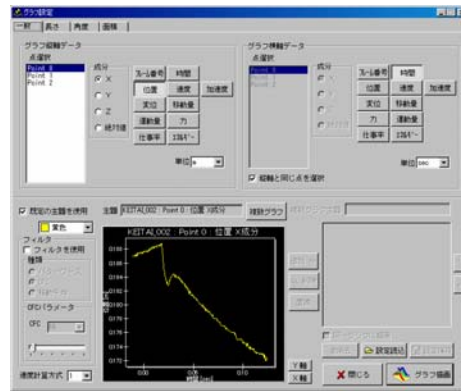


Figure 99 Graph Settings Screen

Step-2: In the block labeled “Data for Vertical Axis of Graph” at the upper left, select Point 2 in Select Points, Y in Components, displacement as the data and mm as the units. (Figure 100)



Figure 100 “Data for Vertical Axis of Graph” Block Settings

Step-3: Click on “Draw Graph”. This creates the graph shown in Figure

101.

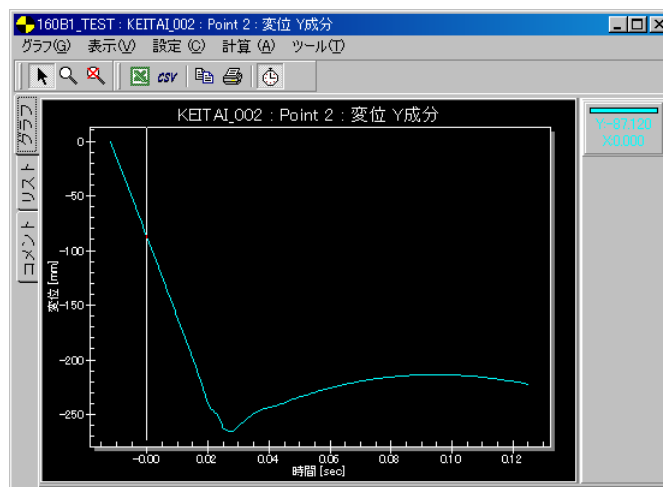


Figure 101 Example of Graph (Single Data)

Refer to “エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。
(→page エラー! ブックマークが定義されていません。)” to create graphs.

2-2) Example of Process to Create Multiple Graphs

This is an example of the process creating a graph of the Point 2 Y displacement (unit: mm) and Y velocity (unit: mm/s) over time (horizontal axis).

Step-1: Access the graph settings screen in the same manner as that in the example for a (single data) graph.

Step -2: Click on “Multiple Graphs” (section H).

Step -3: In the block labeled “Data for Vertical Axis of Graph” at the upper left, select Point 2 in Select Points, Y in Components, displacement as the data and mm as the units. (Figure 102)



Figure 102 “Data for Vertical Axis of Graph” Block Settings

Step-4: Click on the “Add >>” button.

The displacement data for the Y component is entered in section M. (Figure 103)

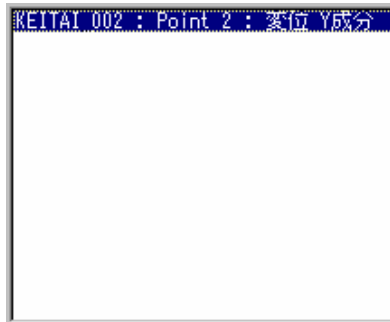


Figure 103 Entering Y Displacement Data

Step-5: In the same manner, in the block labeled “Data for Vertical Axis of Graph” at the upper left, select Point 2 in the Point Selections, Y in Components, velocity as the data and units of mm.

(Figure 104)

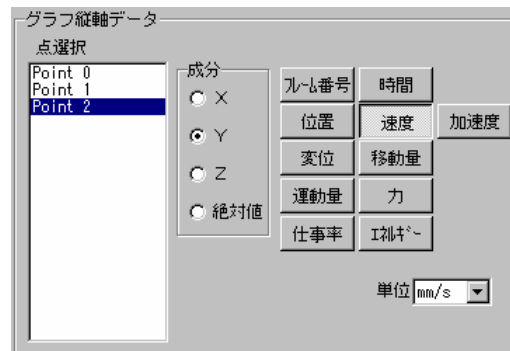


Figure 104 “Data for Vertical Axis of Graph” Block Settings

Step-6: Click on the “Add >>” button.

The velocity data for the Y component is entered in section M. (Figure 105)

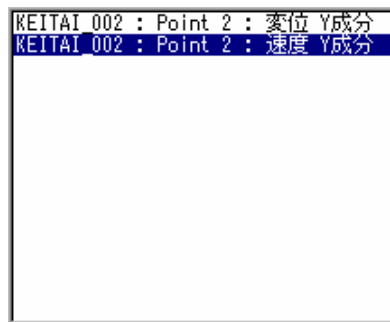


Figure 105 Entering Y Velocity Data

Step-7: Click on “Draw Graph”. This creates the graph shown in Figure 106.

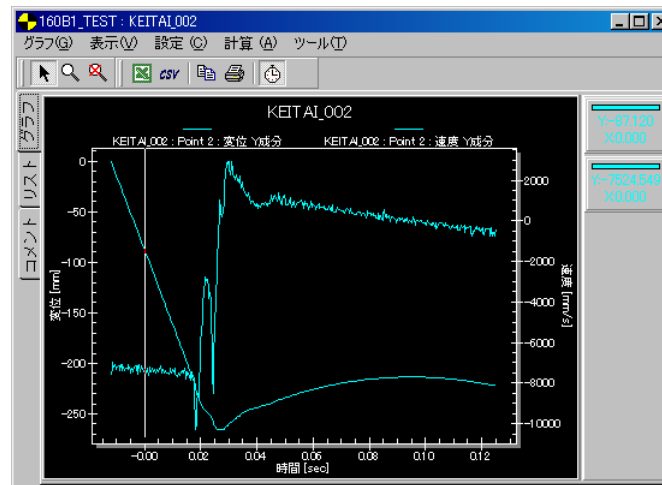


Figure 106 Example of Multiple Graphs

3) Graph Window

This section describes working in the graph window. (Figure 107)

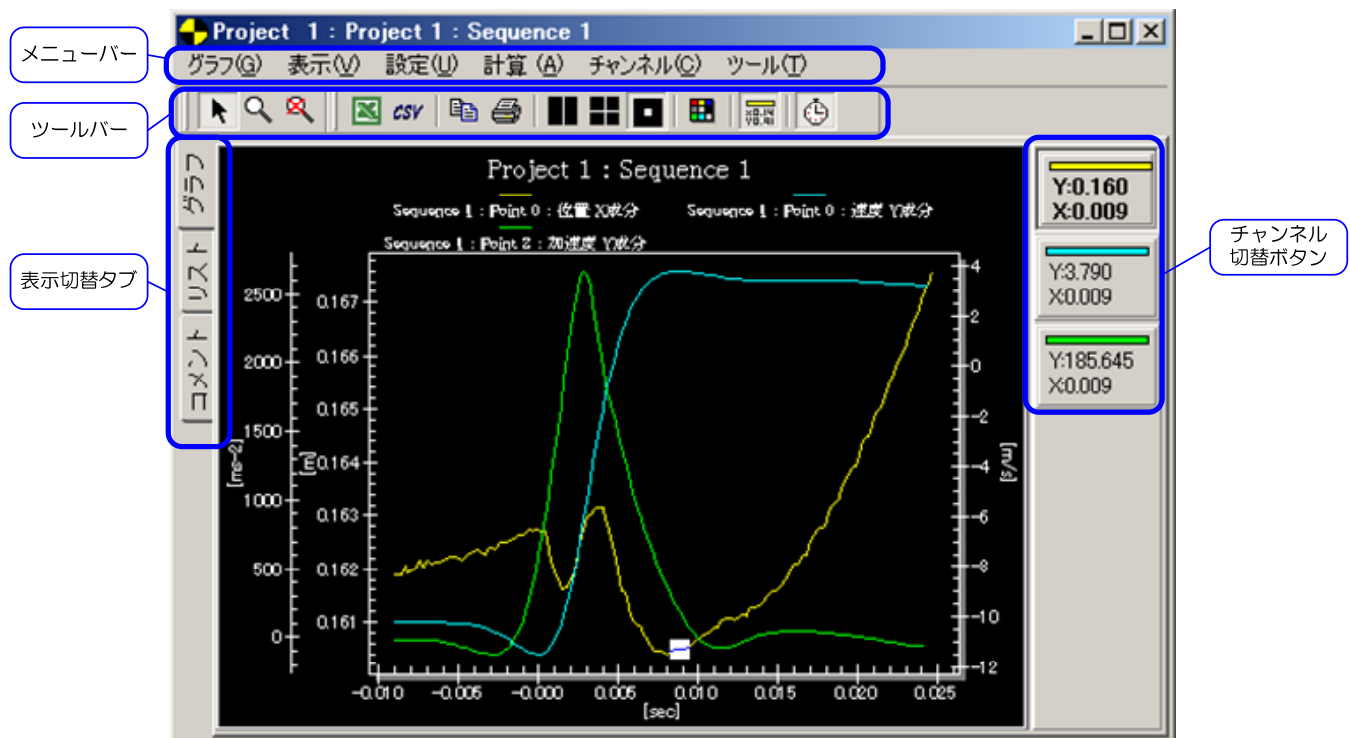


Figure 107 Graph Window

3-1) Graph Menu

As shown in Figure 108, the graph menu has six sub-menus, from graph information to printing.

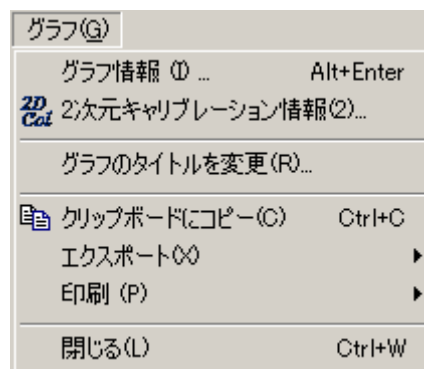


Figure 108 Graph Menu

- Graph Information

As shown in Figure 109, graph information display and settings can be implemented in the graph information menu. Items to be set include the channel name, the X axis data name and the Y axis data name.

グラフ情報

KEITAI_002 : Point 2 : 変位 Y成分

チャンネル名 KEITAI_002 : Point 2 : 変位 Y成分

AVIファイル名 C:\Movias Pro\Images\AVI\KEITAI_002.avi

シーケンス名 KEITAI_002

X軸データ KEITAI_002:Point 2 : Time

Y軸データ KEITAI_002:Point 2 : Y Displacement

X軸単位 sec 先頭時間 -12 ms

Y軸単位 m 時間間隔 0.25 ms

	Y (m)	X (sec)	フレームNo.	時間(ms)
Y軸最大値	0	-0.012	0	-12
Y軸最小値	-0.127878	0.0265	154	26.5
X軸最大値	-0.10712	0.12525	549	125.25
X軸最小値	0	-0.012	0	-12

OK キャンセル(C)

Figure 109 Graph Information

- 2-dimensional Calibration Information

In the 2-dimensional calibration information menu, the status of 2-dimensional calibration at the point where the graph was created is displayed. (Figure 110) However, it is not possible to reset the calibration for reference in this screen.

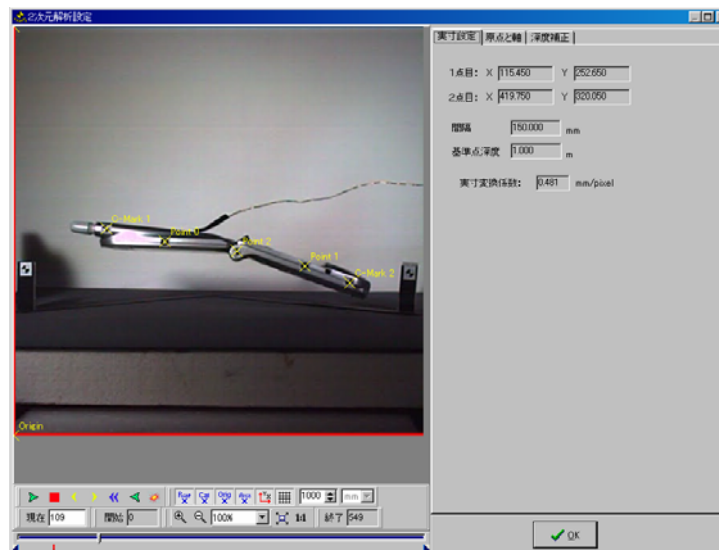


Figure 110 2-dimensional Calibration Information

- Change Name

Use this menu to change the main title of the graph.

- **Copy to Clipboard**
Use this menu to copy graphs to the clipboard as images. The copy format is the Enhanced Windows MetaFile format. Image files can be saved using an application such as “Paint” by attaching to a word processing document.
- **Export CSV File**
Use this menu to output data displayed in a graph to a text file with CSV Graph Data in Movias Format (→page 67).
- **Export Output to Excel**
If Microsoft Excel is installed on the computer, use this menu to output data displayed in a graph with CSV Graph Data in Movias Format (→page 67) directly to Excel.
- **Export T/HIS**
Use this menu to output data displayed in a graph and time data to a text file. If there are multiple graphs, single data can be output to text files.
Select this menu to open the dialogue box specifying the output destination and file name for the text file and specify these. T/HIS format text files can be created for single data. For example, two T/HIS format text files can be created to correspond to each point from a time change graph for the Y coordinates of Point 0 and Point 1. At this point, the dialogue box specifying the output destination and file name for each point will continue to remain open.
- **Print Print**
Prints graphs with the printer.
- **Print Old Printer/File Menu**
This is a menu to maintain compatibility with old versions.

3-2) Display Menu

As shown in Figure 111, use the display menu to turn the graph toolbar and graph legend ON/OFF.

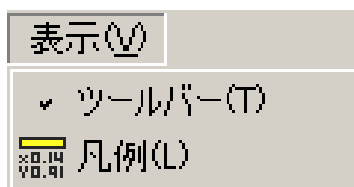


Figure 111 Display Menu

3-3) Settings Menu

As shown in Figure 112, the settings menu executes detailed graph settings, selection of cursor shape and selection of fonts for list display.

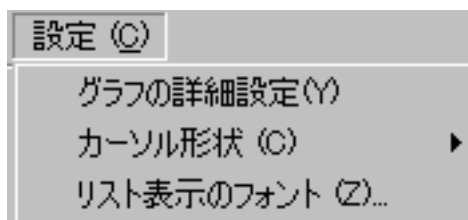


Figure 112 Settings Menu

- Detailed Graph Settings

Use the “Detailed Graph Settings” menu to customize graphs. This is shown in the screen from Figure 113.

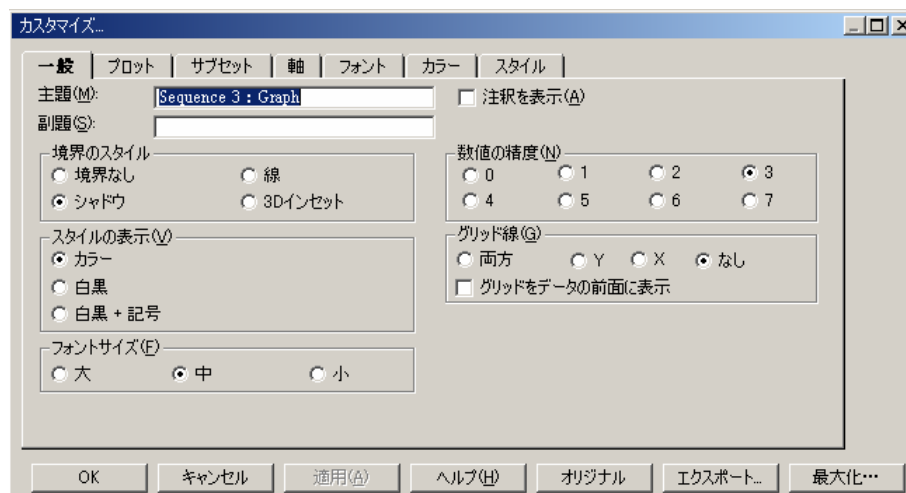


Figure 113 Customized Menu

Next is a description of typical tabs.

>> Axis Tab → Change Scale

Click the “Axis” tab to change the scale of the axis. (Figure 114)

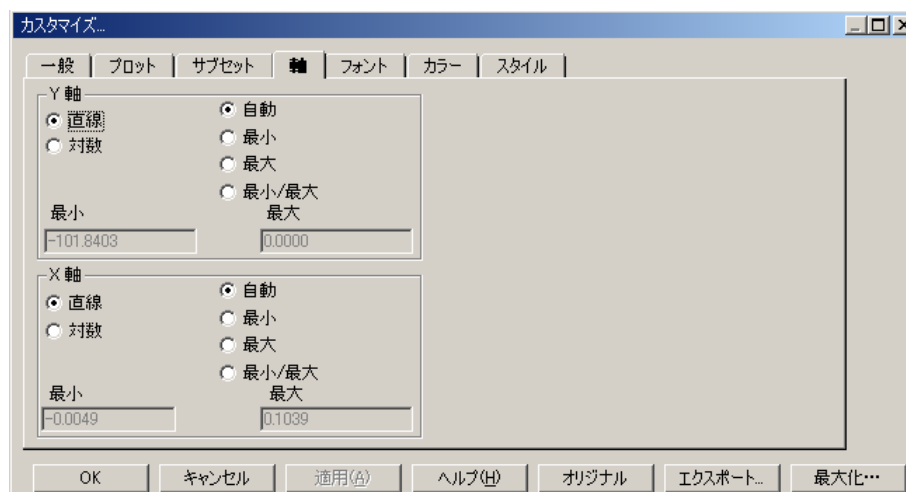


Figure 114 Change Scale

The minimums/maximums for each axis can be checked on this screen and the minimum/maximum values for the scale of the axis can be set as desired. The maximum value for the axis scale can be set by checking the maximum.

>> Color Tab → Change Color in Graph Section

Click on the “Color” tab to change the color in a section of the graph. (Figure 115)

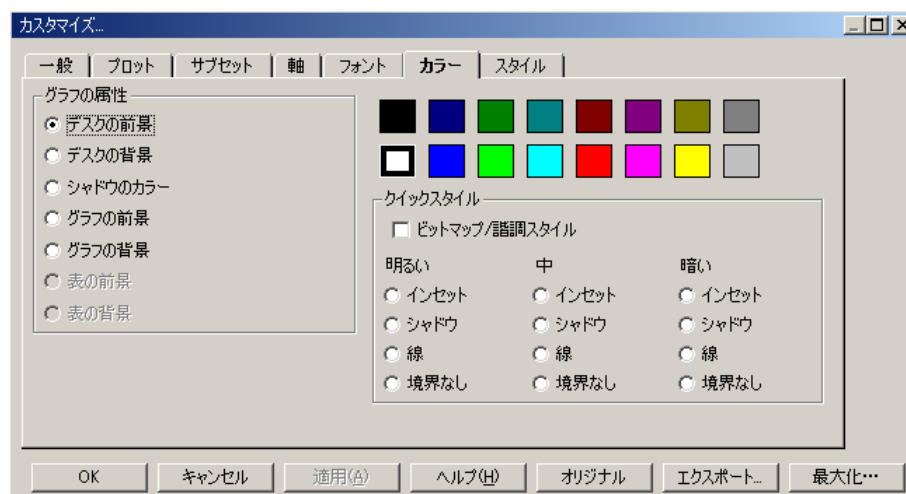


Figure 115 Change Color in Graph Section

The sections where the color can be changed include the foreground of the desktop, the background of the desktop, shadow color, graph foreground, and graph background. Select the target section from the left side of the screen and select the color from the right side. The sections corresponding to the graph are as follows. Use the graph in Figure 116 as an example. This graph is created with default section colors.

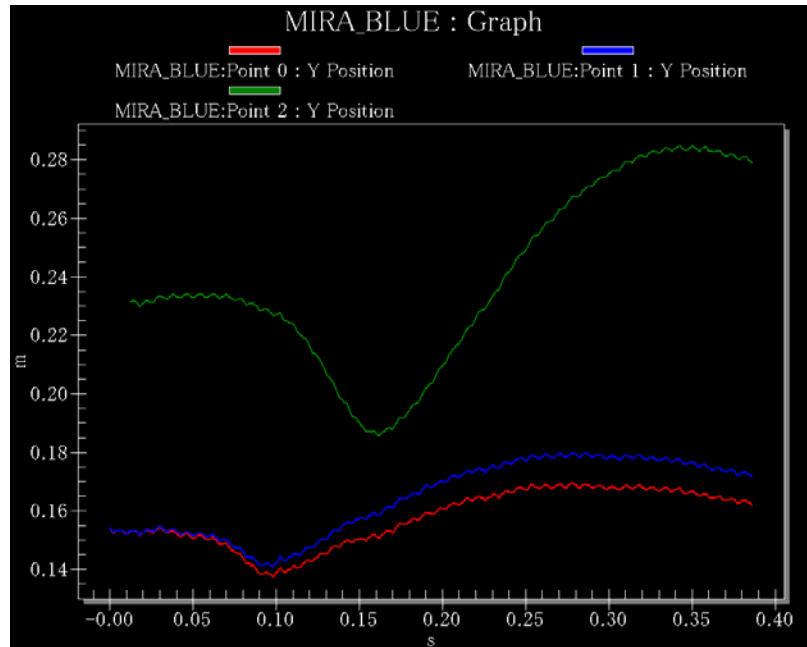


Figure 116 Graph with Default Settings

The graph in Figure 117 is created using black in all of the sections.

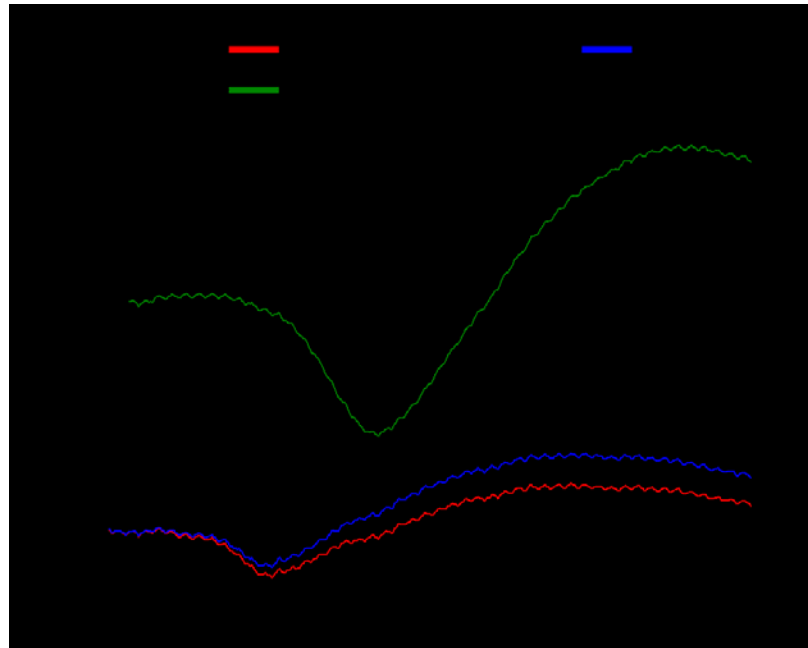


Figure 117 Graph using Black in All of the Sections

The next graph is based on the graph in Figure 117 where all of the sections

are white. Each section can be seen.

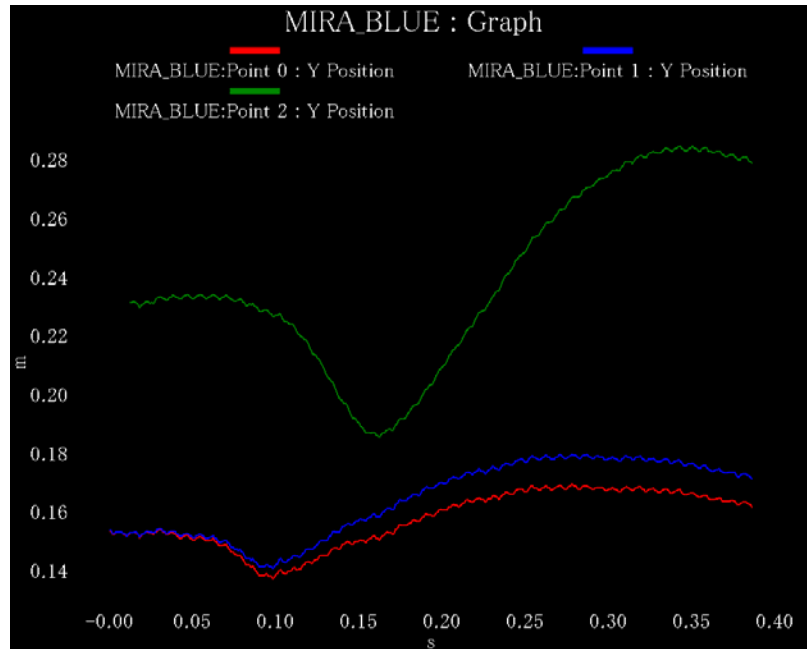


Figure 118 Example of White Desktop Foreground

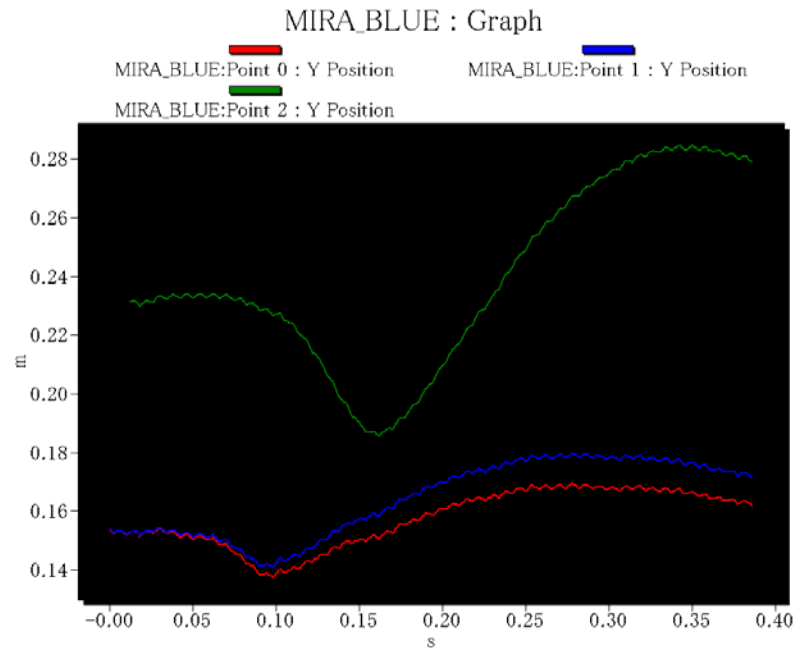


Figure 119 Example of White Desktop Background

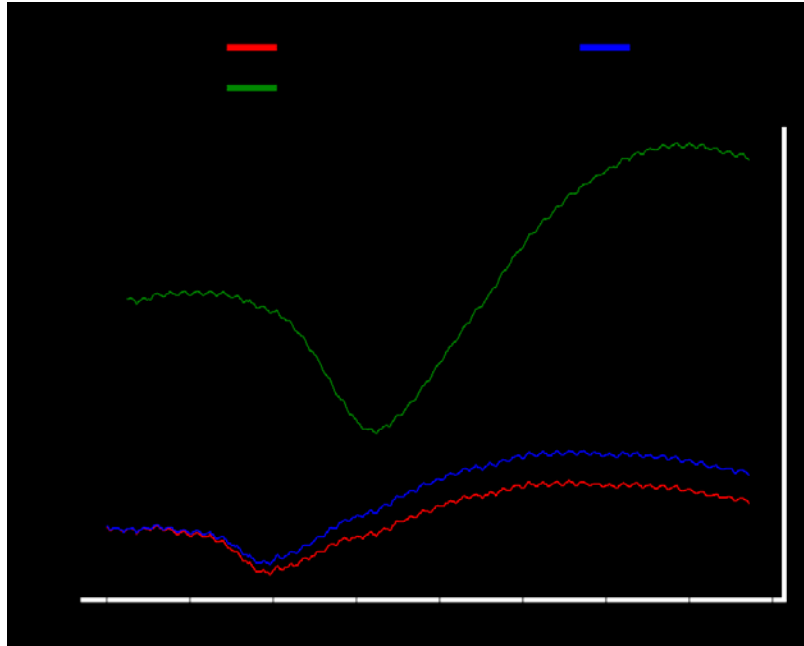


Figure 120 Example of White Shadow

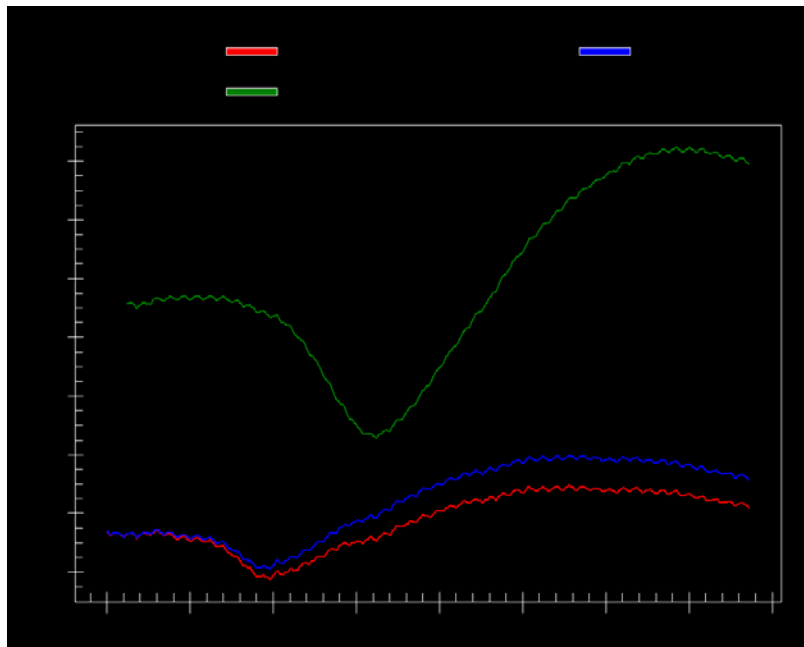


Figure 121 Example of White Graph Foreground

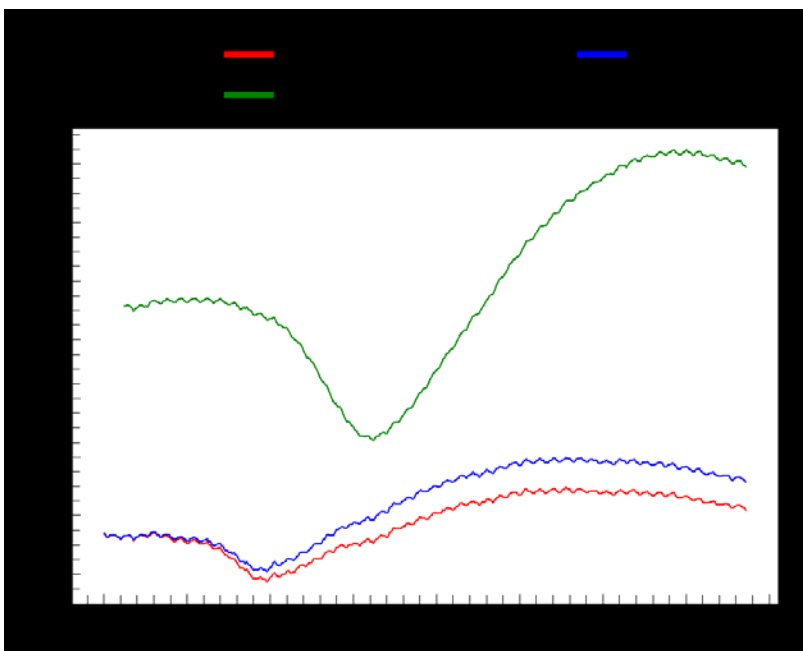


Figure 122 Example of White Graph Background

>> Style Tab → Change Style of Data Lines
Click on the “Style” tab to change the style of the data lines.
(Figure 123)

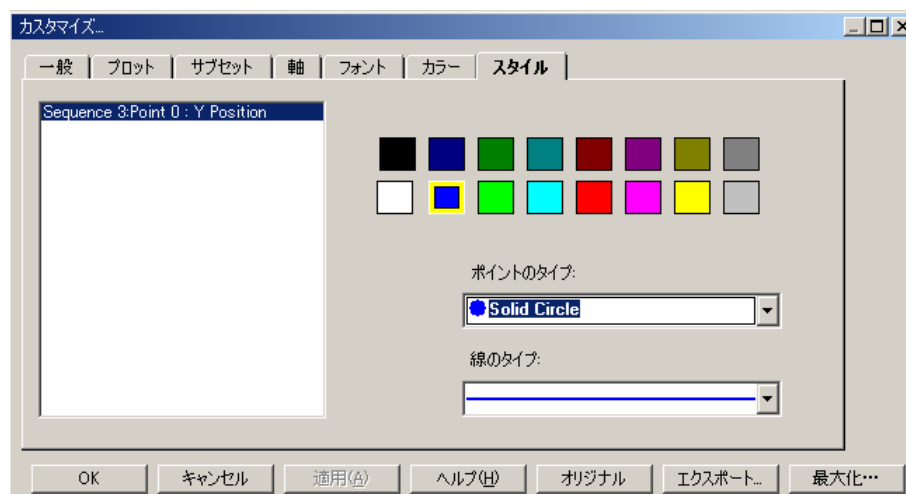


Figure 123 Change Style of Data Lines

Select the data line to be changed on the left side of the screen and specify the color, type of point and the line type on the right side.

- Cursor Shape

Use the cursor shape menu (Figure 124) to select the cursor shape displayed in the graph as a vertical line/crossed lines/square.

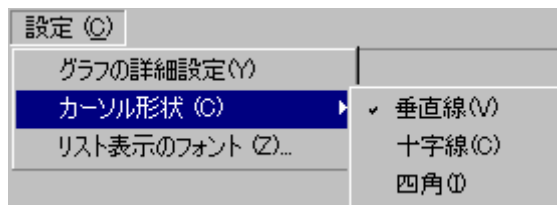


Figure 124 Cursor Shape Menu

Characteristics of each cursor are as follows.

Vertical Line: Times are very easy to read when the horizontal axis of the graph is time data.

Crossed Lines: In addition to the characteristics of the vertical line cursor, data values on the vertical axis are very easy to read.

Square : Effective with trajectory figures (with the X coordinates on the horizontal axis and the Y coordinates on the vertical axis).

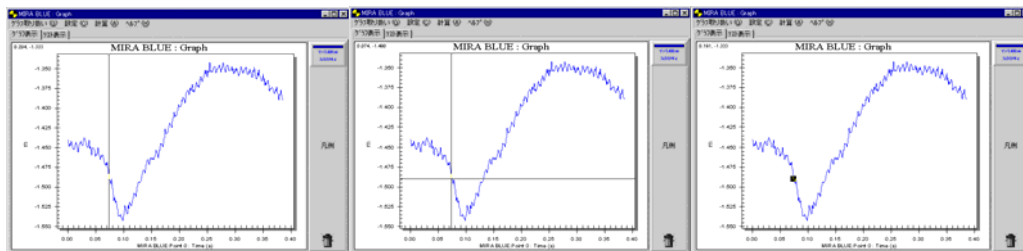


Figure 125 Examples of Vertical Line/Crossed Lines/Square Cursors

If there is multiple data displayed and crossed lines or square cursors are selected, select the channel to display the cursor. 3-4) Select Channel→page 135)

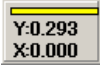
- Fonts for List Display

Use this menu to set the font and size for list output.

3-4) Select Channel

There are several ways to select channels.

a) Click Select Channel

Click Select Channel  in the graph window on the right side to select channel.

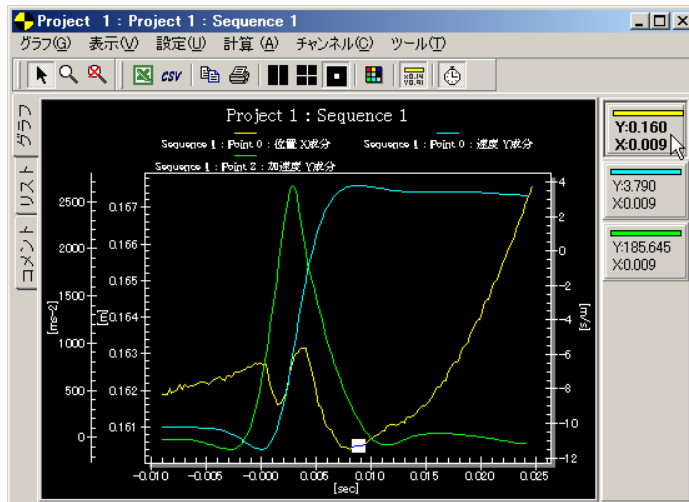


Figure 126 Select with Select Channel

b) Click Graph Line

Select by clicking on a line on the graph.

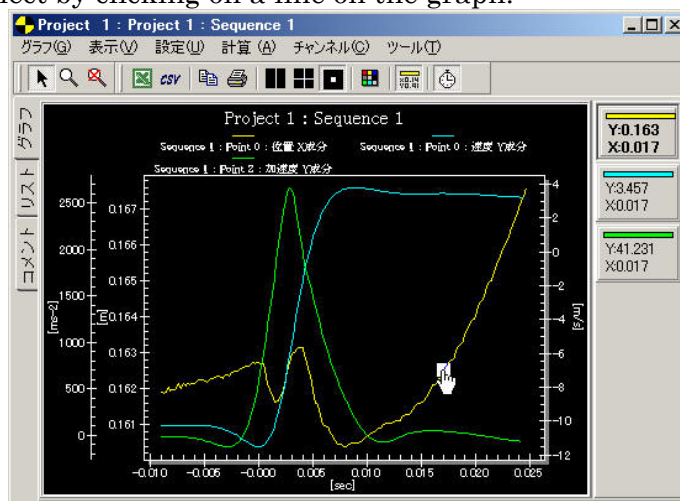


Figure 127 Select by Clicking Line

c) Click Graph Legend

Select by clicking on the legend in the graph.

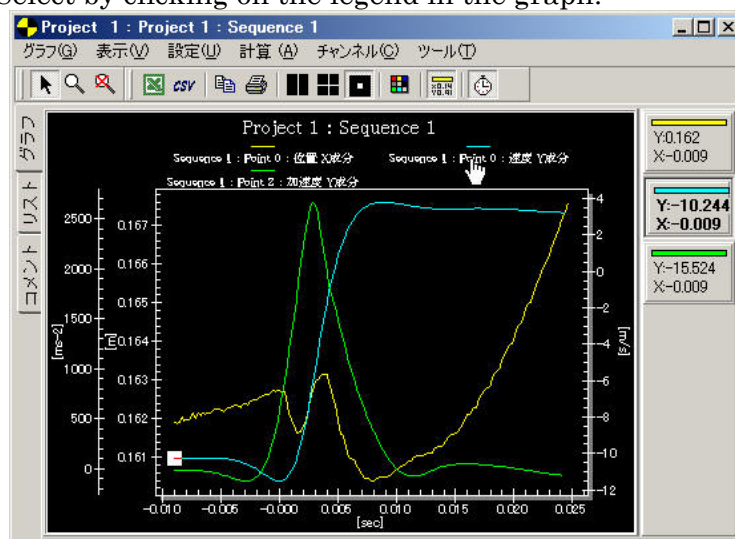


Figure 128 Select by Clicking Legend

3-5) Calculate - Highlight Symbol menu

Use this menu (Figure 129) to temporarily highlight data symbols displayed on the graph. First, select the channel to highlight the symbol. Then, click on the Highlight Symbol menu.

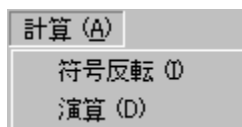


Figure 129 Highlight Symbol Menu

3-6) Calculate—Arithmetic Menu

Use the “Calculate—Arithmetic” menu to execute special calculations on the data displayed on the graph. An example of such use is as follows.

“Multiply the graph shown in meter units by 1000 to change to millimeter units.”

With Movias Pro, millimeter units can be selected in graph settings. The probability of needing “Multiply the graph shown in meter units by 1000 to change to millimeter units” is slim but is described here because it is an example of the arithmetic menu that is easy to understand.

- After the graph is displayed, specify “Calculate – Arithmetic” menu on the graph screen.
- Select the “Arithmetic for Single Data” tab to display Figure 130. Follow this figure for a description of the process.

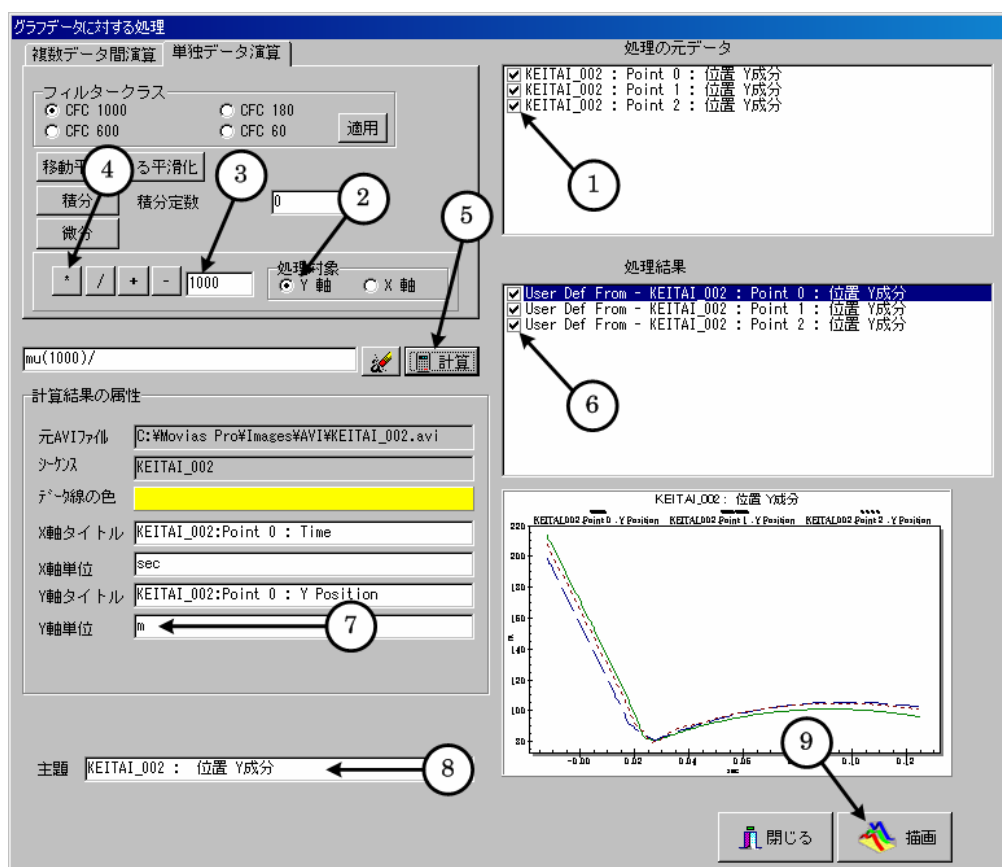


Figure 130 Arithmetic for Single Data Screen

- ① Select the data to be multiplied by 1000 and check the boxes at the front of these rows. If multiple data is displayed in the original graph, it is displayed in this section so check the boxes of the data to be processed.
- ② Specify either the X axis data or the Y axis data to be processed.
- ③、④ Specify the processing to be performed. In this case, input 1000 in the list box (③) and click * for multiplying (④). $\mu(1000)$ will then be entered in the operation box under the operation. μ is an abbreviation for multiple.
- ⑤ After specifying the process, press "Calculate". Processing for the data selected in ① is conducted and the results are entered in ⑥.
- ⑥ Check the boxes at the front of the rows.
- ⑦ Convert the Y axis data units from m to mm.
- ⑧ Change the name of the graph as necessary.
- ⑨ Press "Draw" to display the graph after processing.

3-7) Channel Menu

The channel menu operates all of the channels.

Please refer to 3-11)~ 3-13) for details. (→page 143)

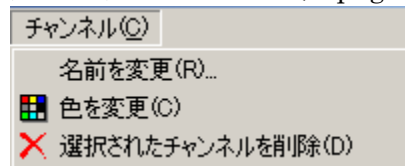


Figure 131 Channel Menu

- Change name
- Change color
- Delete the selected channel

3-8) Tools Menu

The Tools menu performs the following processing for graphs, as shown in Figure 132.

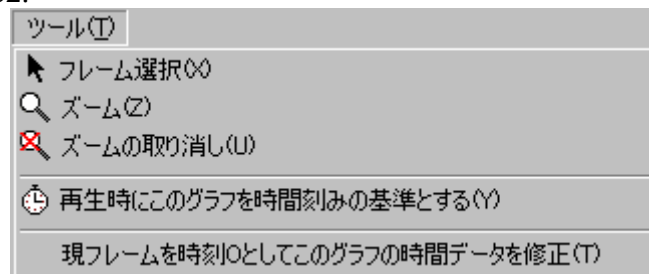


Figure 132 Tools Menu

- Select Frame

In this menu, click and drag the mouse on the graph screen to select the frame corresponding to the position of the cursor.

- Zoom

Click and the cursor will become a magnifying glass. Drag to the area to be zoomed.
This will zoom the area inside.

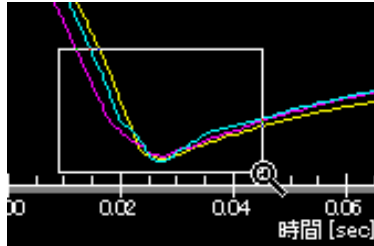


Figure 133 Zoom Screen

- Cancel Zoom

This menu cancels the zoom and reverts to the original.

- During playback, set the time scale on this graph as the standard

If displaying graphs for multiple sequences or video images with image files of varying photographic speeds, the time data for the graph clicked in this menu is used as the standard for the playback speed. For example, if the image is 1000fps and the waveform data graph is 10000Hz, data is played at 10000Hz sampling intervals.

- Correct the time data for this graph so the current frame is time 0

Click on this menu and the time for the current frame becomes 0 and the time data for the graph is converted. This time data conversion impacts only the graph specified and does not impact the sequence data itself.

3-9) Graph Window Toolbar

The functions of the graph window toolbar are as follows. (Figure 134)
Please refer to the description for each menu for their functions.

- Select Frame
- Zoom
- Cancel Zoom
- Export Output to Excel
- Export Output to CSV File
- Copy to Clipboard
- Print
- Select Cursor
- Change Channel Color
- Display Channel Buttons
- Set the Time Scale on this Graph as the Standard for Playback

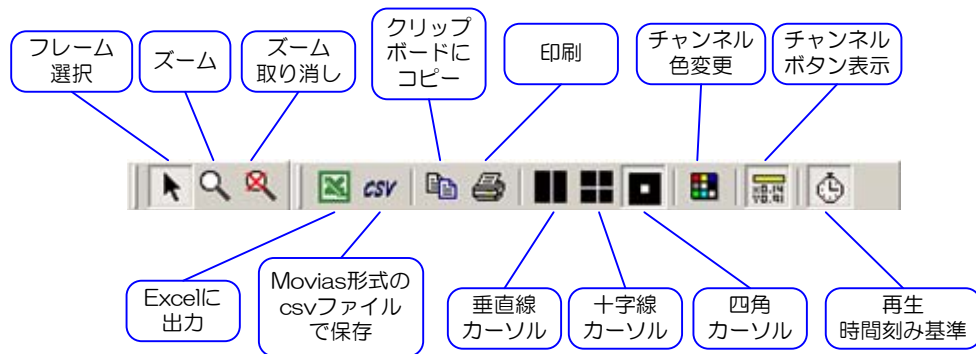


Figure 134 Graph Toolbars

3-10) Copy/Move Data Between Graph Windows Using Drag and Drop

As shown in Figure 135 below, data can be copied or moved using drag and drop when graphs are displayed on two screens.

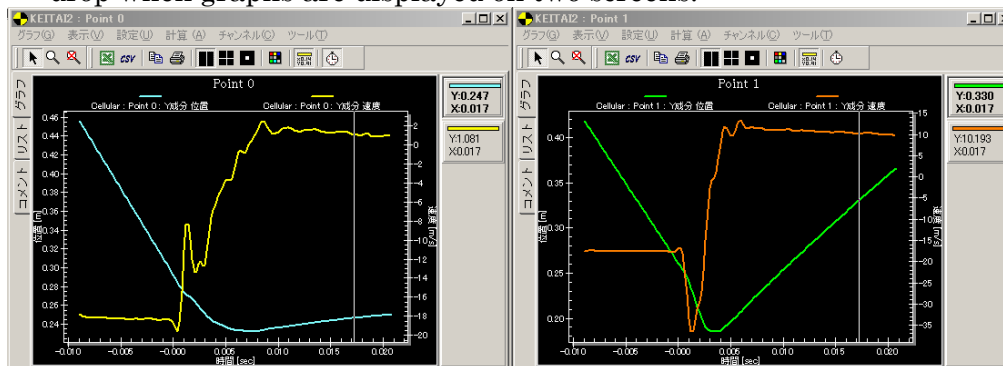


Figure 135 Example of Graphs

To copy data, drag and drop the channel select button for that data to the graph to be copied using the left button on the mouse. (Figure 136) Graphs are created as shown in Figure 137.

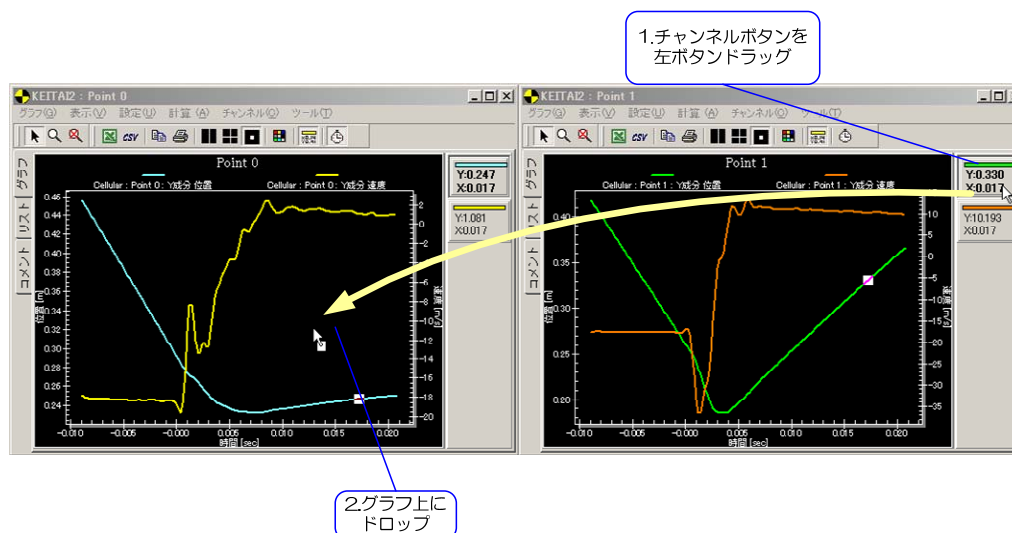


Figure 136 Copy Channel

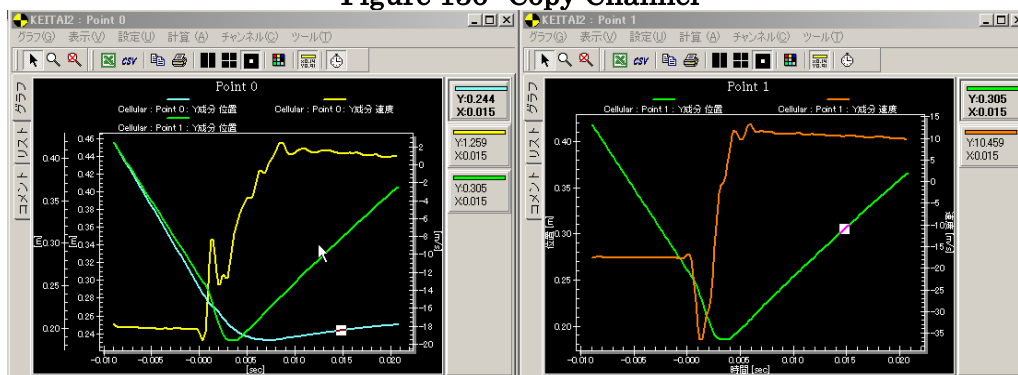


Figure 137 Copied Results

In a similar manner, to move channels, drag and drop the channel select button for that data to the graph to be copied using the left button on the mouse and select “Move” from that menu.

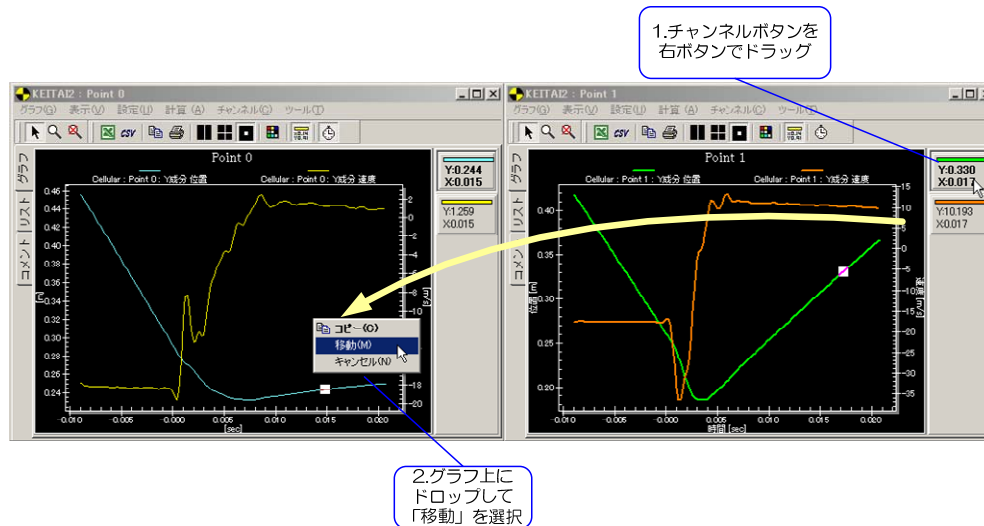


Figure 138 Move Channel

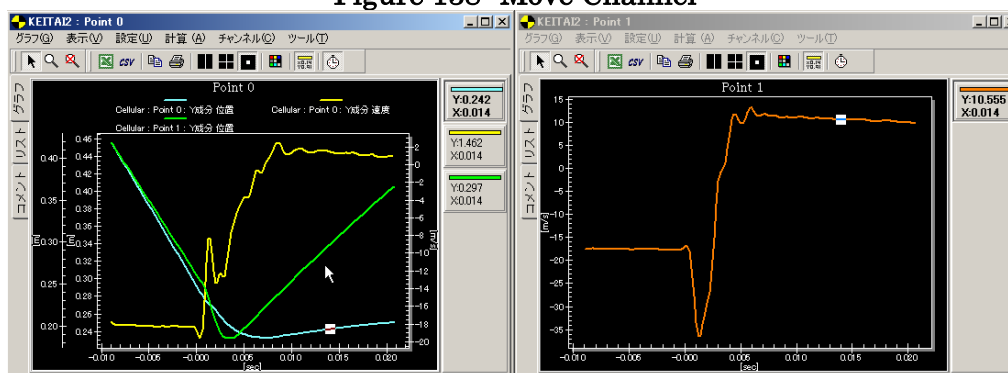


Figure 139 Move Results

3-11) Change the Name of the Graph Channel

The name of the graph channel can be altered. (Figure 140, Figure 141)
Graph channel names are displayed in the multiple line legend section on the right side of the graph window.

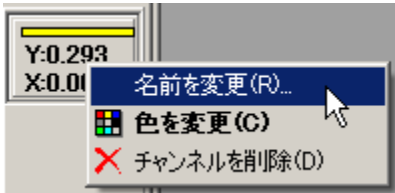


Figure 140 Click Change Name

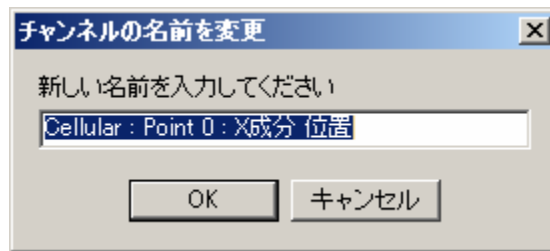


Figure 141 Change Channel Name

3-12) Delete Graph Data

If multiple data is displayed on a single graph, data can be deleted as desired. Right click on the channel corresponding to the data to be deleted and select the "Delete" menu. (Figure 142)

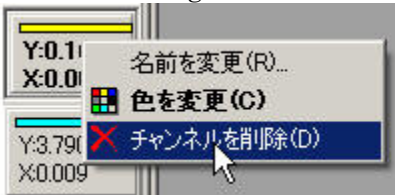


Figure 142 Delete Channel

3-13) Change the Colors of the Lines in the Graph

Right click on the channel corresponding to the graph where the colors are to be changed and select the "Change Colors" menu. (Figure 143)

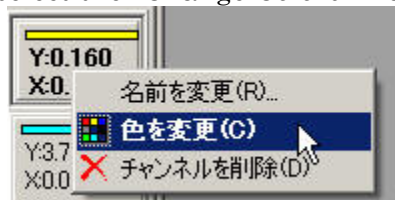
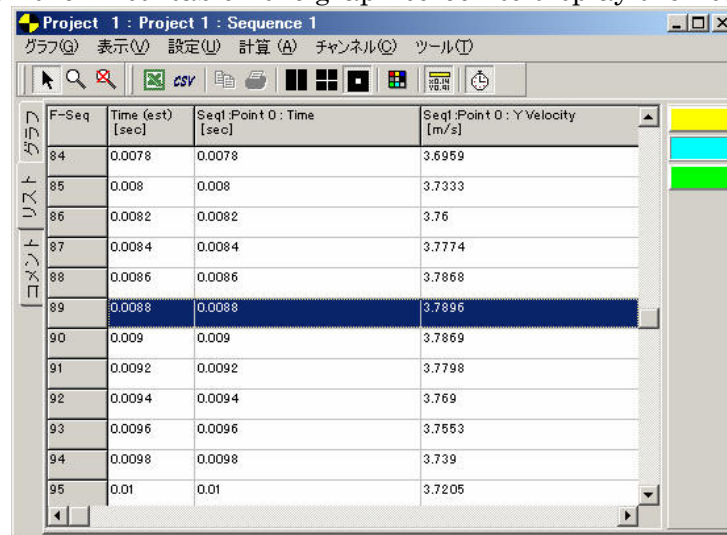


Figure 143 Change the Colors of the Channels

3-14) Graph List Display

Click on the “List” tab on the graph screen to display the list. (Figure 144)



The screenshot shows the 'List' tab selected in the software interface. The table displays data points for 'F-Seq', 'Time (est) [sec]', 'Seq1 Point 0 : Time [sec]', and 'Seq1 Point 0 : Y Velocity [m/s]'. The row for 'F-Seq' 89 is highlighted in blue.

F-Seq	Time (est) [sec]	Seq1 Point 0 : Time [sec]	Seq1 Point 0 : Y Velocity [m/s]
84	0.0078	0.0078	3.6959
85	0.008	0.008	3.7333
86	0.0082	0.0082	3.76
87	0.0084	0.0084	3.7774
88	0.0086	0.0086	3.7868
89	0.0088	0.0088	3.7896
90	0.009	0.009	3.7869
91	0.0092	0.0092	3.7798
92	0.0094	0.0094	3.769
93	0.0096	0.0096	3.7553
94	0.0098	0.0098	3.739
95	0.01	0.01	3.7205

Figure 144 Display List

3-15) Add Comments to Graph.

Comments can be added to graphs. Click on the “Comments” tab on the graph screen to display comments. These comments can be output to the end of data output to Excel/CSV. (Figure 145)

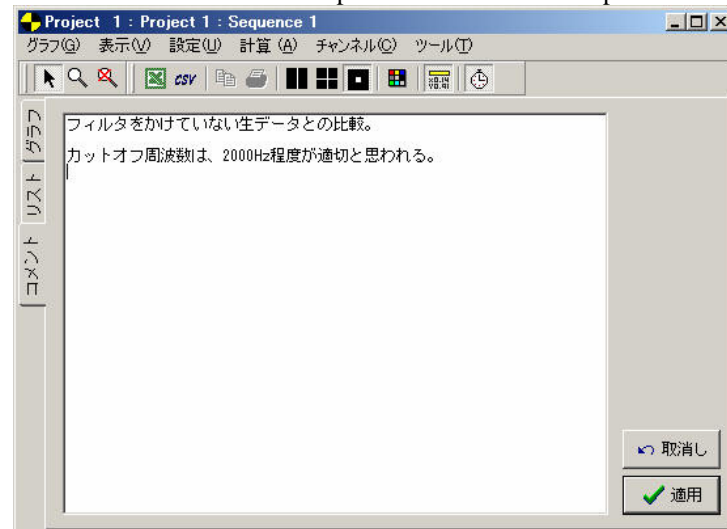


Figure 145 Edit Comments

3-16) Right Click Menu and Double Clicking on the Graph Windows

In addition to channel buttons, there is a right click menu on the graph windows with “Legend”, “Axis” and “Title”, that conduct several operations. If double clicked instead of right clicking, the items in bold on the right click menu will be implemented.

Please review the description for each item on the menu corresponding to the main menu for these functions. (Refer to the detailed settings for each item in the quick settings menu)

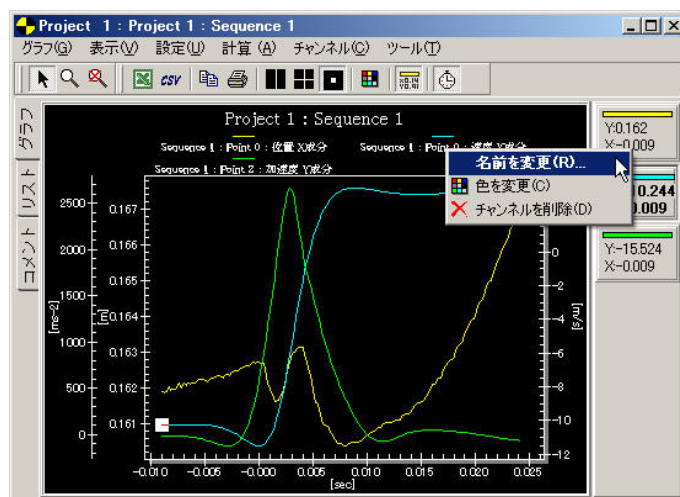


Figure 146 Right Click Menu on Legend (Channels)

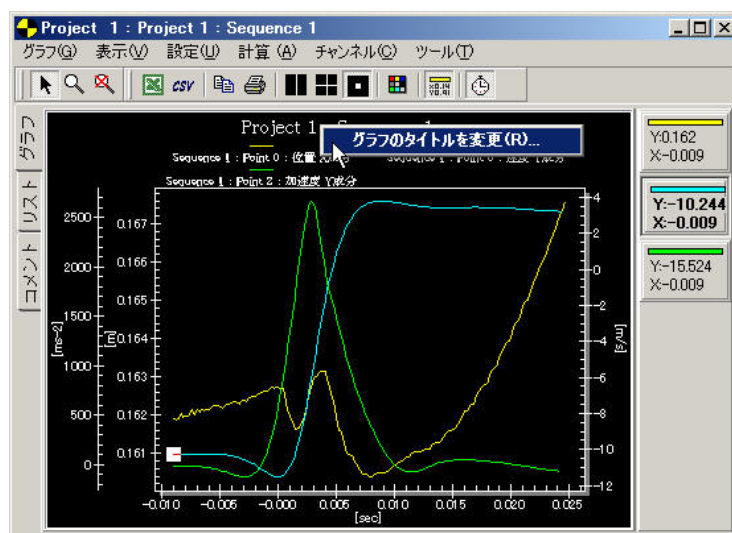


Figure 147 Right Click Menu on Titles

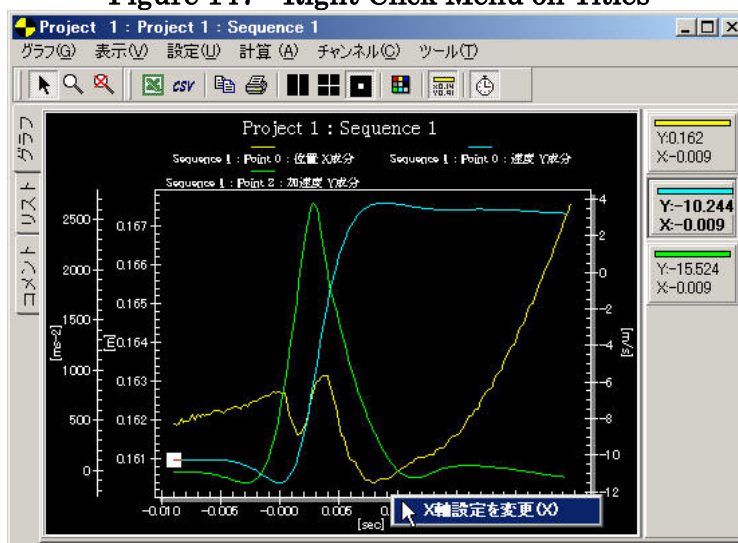


Figure 148 Right Click Menu on X Axis

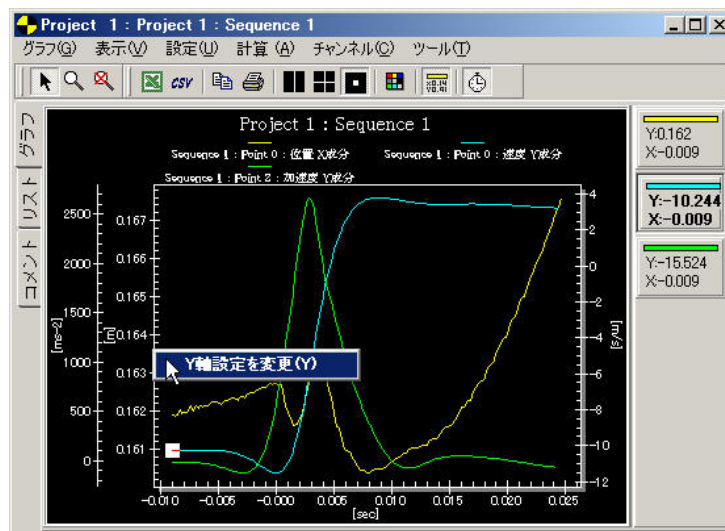


Figure 149 Right Click Menu on Y Axis

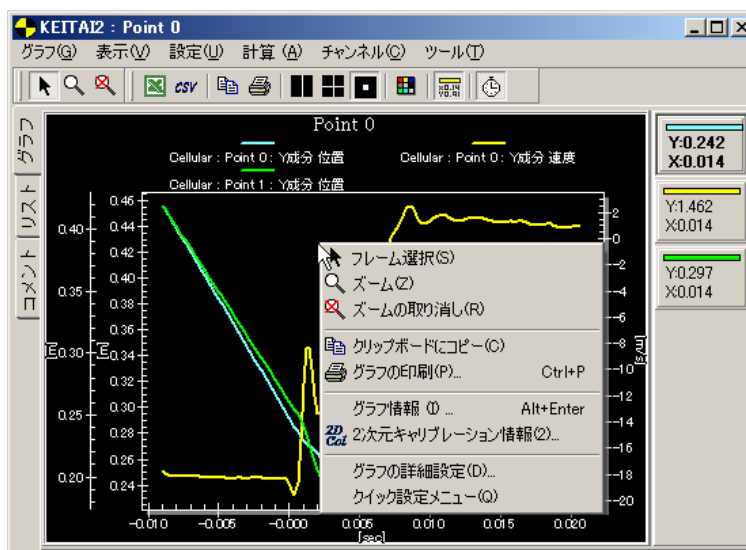


Figure 150 Graph Area (Right Click Menu on Desktop)

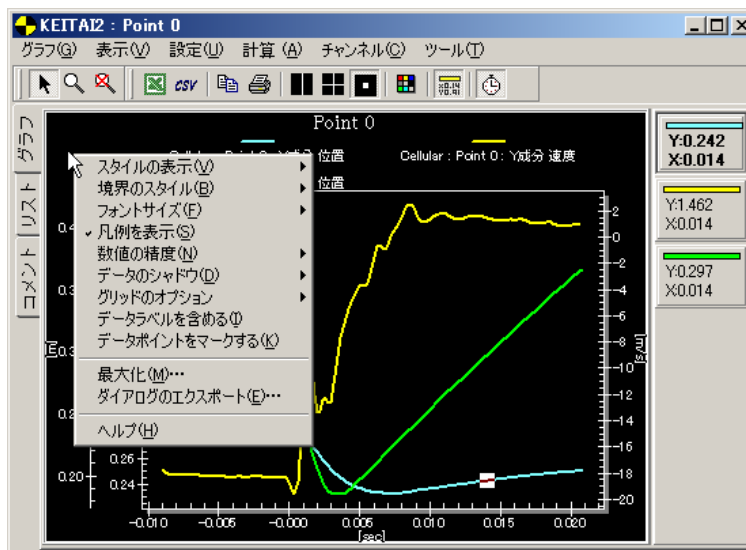



Figure 151 Graph Area (not desktop) Right Click Menu (Quick Settings Menu)

4.4.3 Trajectory Graphs

Click on “Create Trajectory Graph” on the Display Results menu or the trajectory tool  and the dialogue box shown in Figure 152 will open. Click “OK” to change the graphs or axis titles and units as necessary. Next, the trajectory will be displayed in graph format, as shown by the example in Figure 153. The functions of this menu and toolbar are identical to that in graphing.²²

After creating the trajectory graph, switch display/do not display to select the points to draw on the trajectory graph. Refer to “4.9.3 Right Click Menu for Tracking Points (→page 186)” for details.

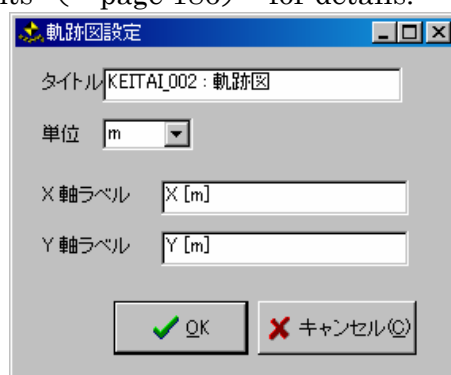


Figure 152 Dialogue Box for Trajectory Figure Settings

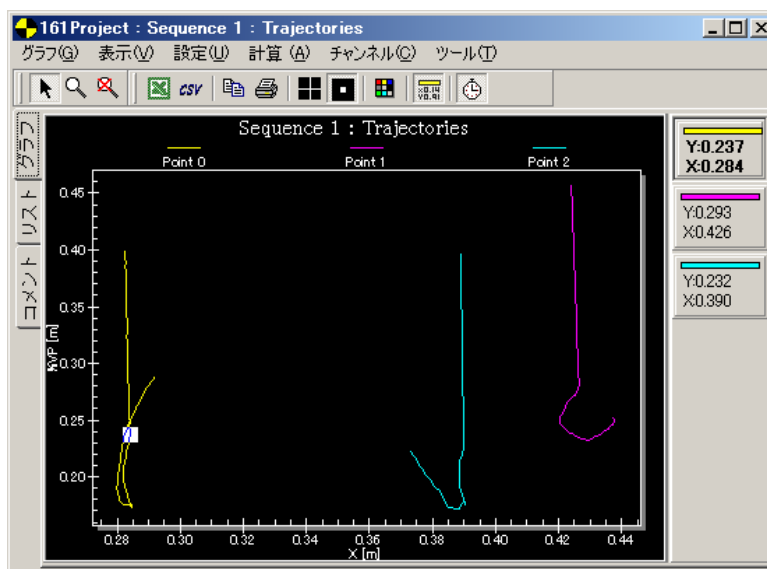


Figure 153 Example of Trajectory Figure

²² The frame selection process for trajectory figures differs from that for graphs. For trajectory figures, align the cursor on the data line and click when the cursor changes to the shape of a hand.

4.4.4 Graph Template

Graph Template is a function to create graphs without using the Graph Settings screen, by following the settings saved in “4.4.21-14) Section (→ page 120)”. This is useful when conducting standard analysis. (Refer to 4.4.21-14) Section for the method to create graph template files.)

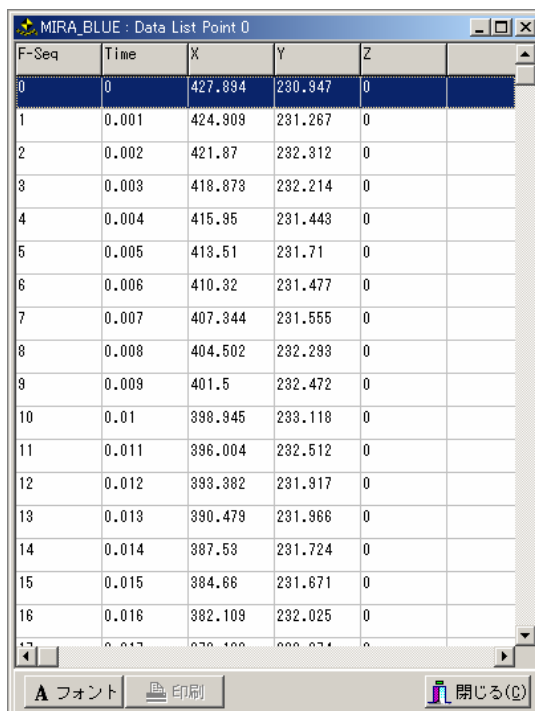
Select the “Display Results – Create Graph Template” menu or the graph template tool on the toolbar to create a graph from a graph template file.

Select the desired graph template file from the dialogue box displaying the saved settings.

Multiple graphs can be created at one time by selecting multiple graph templates.

4.4.5 Lists

First, select the tracked points to be output to the list by clicking on the data tree. Select the “Display Results –Lists” menu or click Lists on the toolbar button list. A list such as that shown in the example in Figure 154 will be displayed.



F-Seq	Time	X	Y	Z
0	0	427.894	230.947	0
1	0.001	424.909	231.267	0
2	0.002	421.87	232.312	0
3	0.003	418.873	232.214	0
4	0.004	415.95	231.443	0
5	0.005	413.51	231.71	0
6	0.006	410.32	231.477	0
7	0.007	407.344	231.555	0
8	0.008	404.502	232.293	0
9	0.009	401.5	232.472	0
10	0.01	398.945	233.118	0
11	0.011	396.004	232.512	0
12	0.012	393.382	231.917	0
13	0.013	390.479	231.966	0
14	0.014	387.53	231.724	0
15	0.015	384.66	231.671	0
16	0.016	382.109	232.025	0
17	0.017	379.488	232.874	0

Figure 154 Example of Display Results – List Output

The contents of this list are as follows.

- Time: Time data in seconds.
- X, Y: For 2-dimensional analysis, the X and Y coordinates for the tracked points for pixels, with the starting point at the top left of the screen.
For 3-dimensional analysis, the X and Y coordinates for the tracked points.
- Z: For 2-dimensional analysis, the distance data from the camera. (if conducting depth correction)
For 3-dimensional analysis, the Z coordinates for the tracked points.

4.4.6 3D Stick Animation

This menu provides a 3-dimensional display of a stick figure. Use the slider to change the line of vision²³.

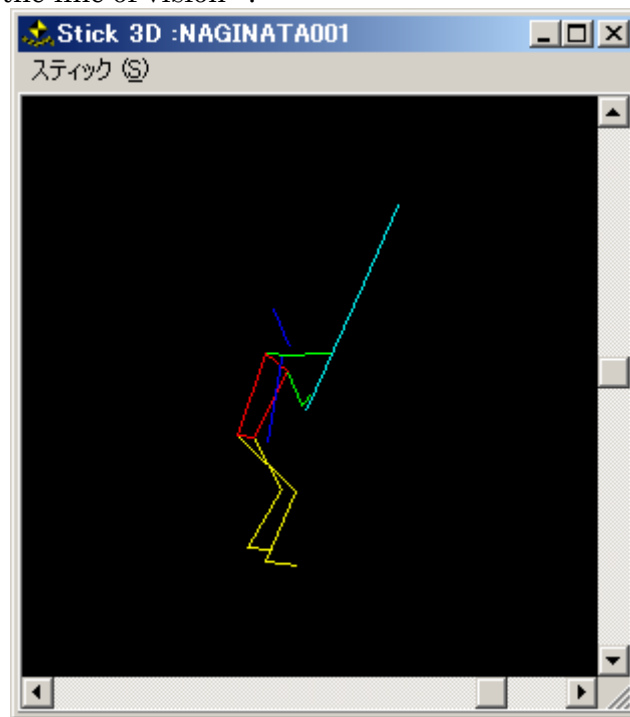


Figure 155 Example of 3-dimensional Stick Animation

²³ To display 3-dimensional stick animation, the stick in the 3-dimensional sequence displaying this must be defined. Or, before building the 3-dimensional data structure, a stick definition must be given for one of the multiple 2-dimensional sequences in the 3-dimensional version.

4.5 Menu to Specify Point Combinations

The length, area, angle and virtual points combining multiple tracking points are defined in the “Specify Point Combinations” menu. The center of gravity for the region is determined by the mass data set for each tracking point, which is then applied to the model.

4.5.1 Length

Select the “Length” menu to display the screen shown in Figure 156.

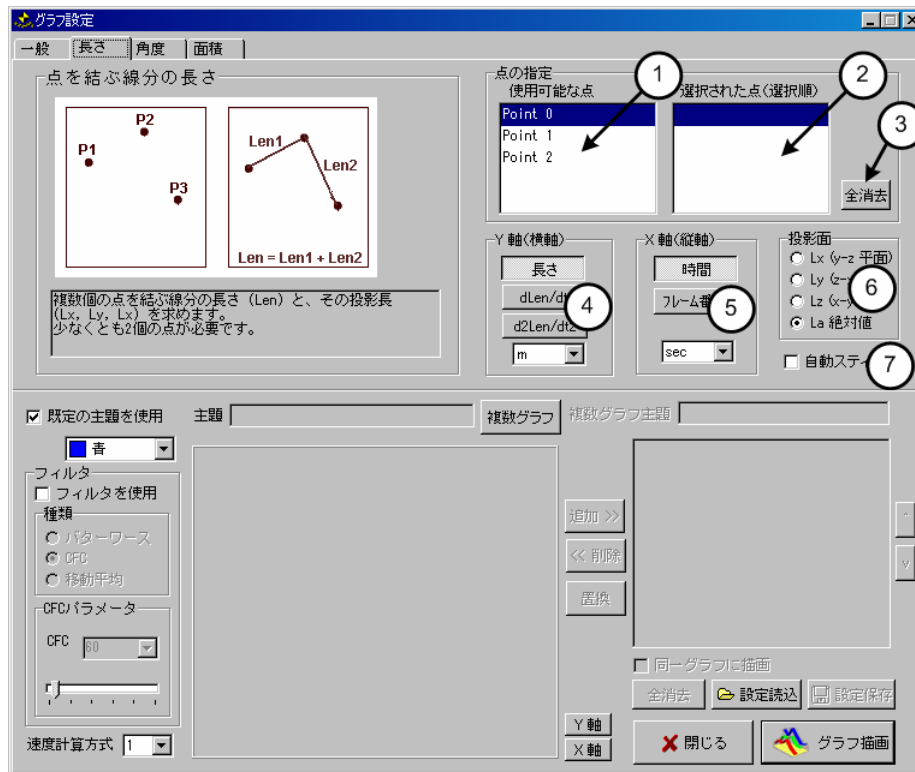


Figure 156 Length Settings Screen

- Select by double clicking on the order of points to create a segment from those tracking points shown in “Available Points ①”. The points selected will be entered as “Selected Points ②”. Two or more tracking points can be selected.
If an error is made in the points selected, either double click on those points to delete or click “Delete All ③” to delete all of the selected points and start over.
- In ④, select the length of the data output and the time change for the length (primary, secondary). Units can be specified at the same time.
- In ⑤, select the horizontal axis data and units.
- If conducting 3-dimensional analysis, in ⑥, check Lx, Ly and Lz to determine the

length when each is projected on a surface with coordinates. Check La to determine the length of the space.

With 2-dimensional analysis, check La.

- Check ⑦ “Automatic Stick” to define a specific length as a stick.
- After selecting, click “Draw Graph”.

The results are displayed as a graph.

- The lower half of the settings screen is the same as that of graph.

4.5.2 Area

Select the “Area” menu to display the screen shown in Figure 157. This functions in the same manner as Length. Three or more points can be selected.

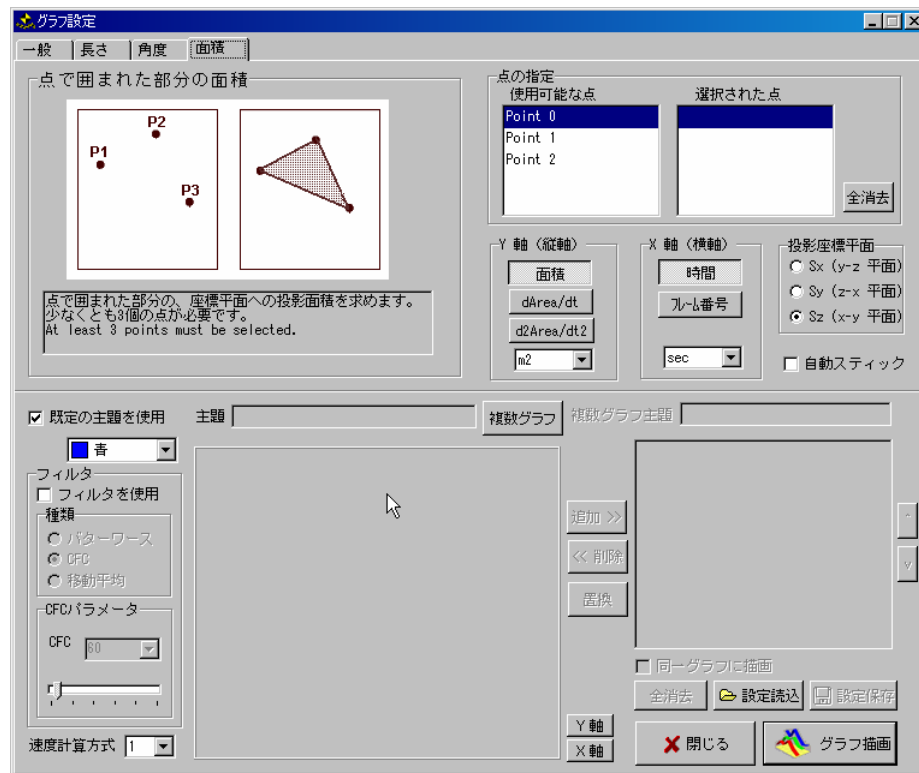


Figure 157 Area Settings Screen

4.5.3 Angle

1) Basis for Angle Settings

In Movias Pro, the following four types of angles can be set.

Type 1: Two line segments of two tracking points are selected and the angle of the intersection of these is determined. With these two line segments,

the first selected becomes the starting point, and the angle is measured clockwise or counterclockwise to the second selected. If selecting line segments with two tracking points, the direction of the line segments follows the order in which the points were selected (the direction from the first point selected to the second point selected). It is easier to understand as vectors. With vectors, if the origin of two vectors is aligned, it is easy to understand the angle of which section is to be determined. It is the same with types 2-4.

Type 2: The angle of sections between 2 vectors is determined²⁴.

With these two vectors, the first vector selected becomes the starting point, and the angle is measured clockwise or counterclockwise to the second vector selected.

Type 3: The angle between the line segment of two tracking points and the coordinate axis is measured. With the coordinate axis as the starting point, the angle is measured clockwise or counterclockwise to the selected line segment.

Type 4: The angle between the vector and the coordinate axis is measured. With the coordinate axis as the starting point, the angle is measured clockwise or counterclockwise to the selected vector.

In addition to angles, data that can be graphed includes angular velocity and angular acceleration. Units that can be specified for each type of data are as follows.

Angle: radian, degrees

Angular velocity: rad/s, deg/s, rpm

Angular acceleration: rad/s², deg/s²

Angles can be expressed in the following three ways.

$-\pi$ to π : The angle expressed as an integer from $-\pi$ (-180 degrees) to π (180 degrees).

If over 180 degrees, for example, 181 degrees is expressed as -179 degrees.

This will appear as an unconnected line when graphed. The same will apply for those with less than -180 degrees.

0 to 2π : The angle expressed as an integer from 0 degrees to 2π (360 degrees).

If items that rotate exceed 360, it will reset at 0. This will appear as an unconnected line when graphed. The same will apply for those with less than 0.

Cumulative angle: To avoid having unconnected lines on a graph such as that when 361 exceeds 360, a continuous angle is determined.

²⁴ Vectors for type 2 and type 4 must be defined as virtual points (described later).

2) Type 1 Angles

The settings screen for Type 1 angles is shown in Figure 158.

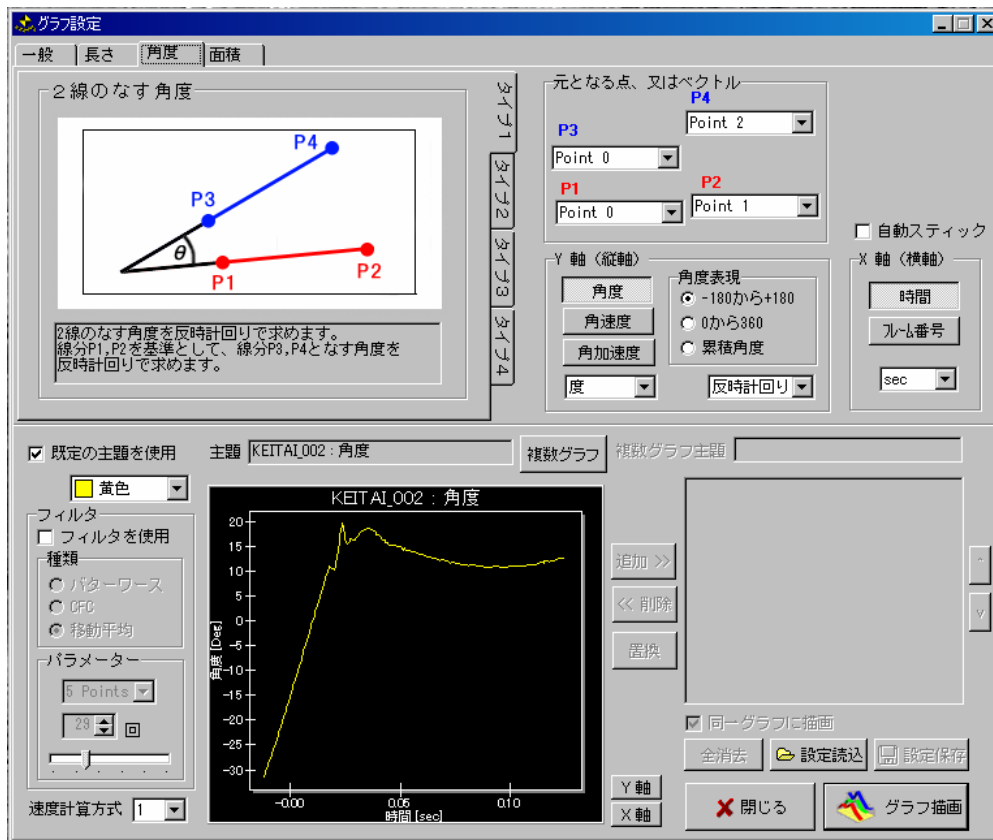


Figure 158 Type 1 Angle Settings Screen

Four points are specified to determine two line segments in the “Starting Points or Vectors” section of this screen. Set two points P1 and P2 specifying the line segment that will become the starting point. Set two points P3 and P4 specifying the second line segment.

Set the data type, unit, angle expression and angle direction in the “Y Axis (vertical axis)” section.

Set the data type and unit in the “X Axis (horizontal axis)” section.

Check “Automatic Stick” to define the stick figure of connected dots using the angle settings.

The bottom half of the screen is identical to graph.

3) Type 2 Angles

The settings screen for Type 2 angles is shown in Figure 159.

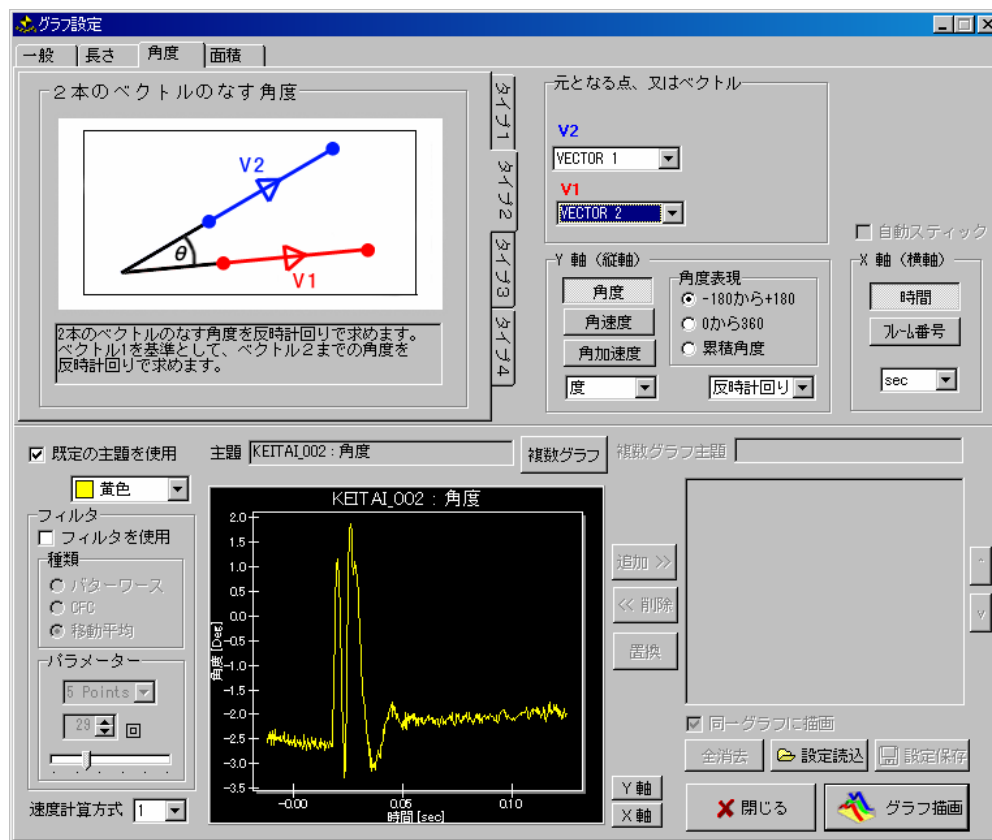


Figure 159 Type 2 Angle Settings Screen

Two vectors are specified in the “Starting Points or Vectors” section of this screen. Set V1 as the vector of the starting point. Set V2 as the second vector. Otherwise, this is identical to that of Type 1. (excluding automatic stick)

4) Type 3 Angles

The settings screen for Type 3 angles is shown in Figure 160.

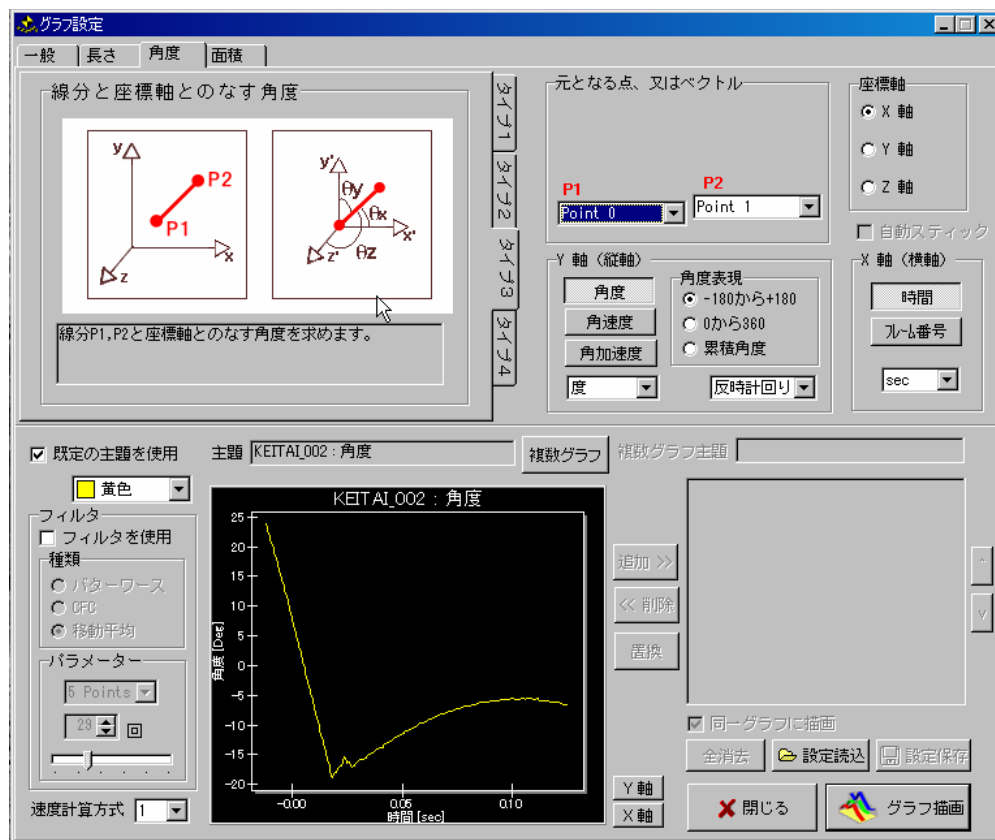


Figure 160 Type 3 Angle Settings Screen

Two points are specified in the “Starting Points or Vectors” section of this screen to determine the line segment. Set the two points designating the line segment as P1 and P2.

Select axis coordinates that will be the standard for measurement of angles in “Axis Coordinates”.

Otherwise, this is identical to that of Type 1. (excluding automatic stick)

5) Type 4 Angles

The settings screen for Type 4 angles is shown in Figure 161.

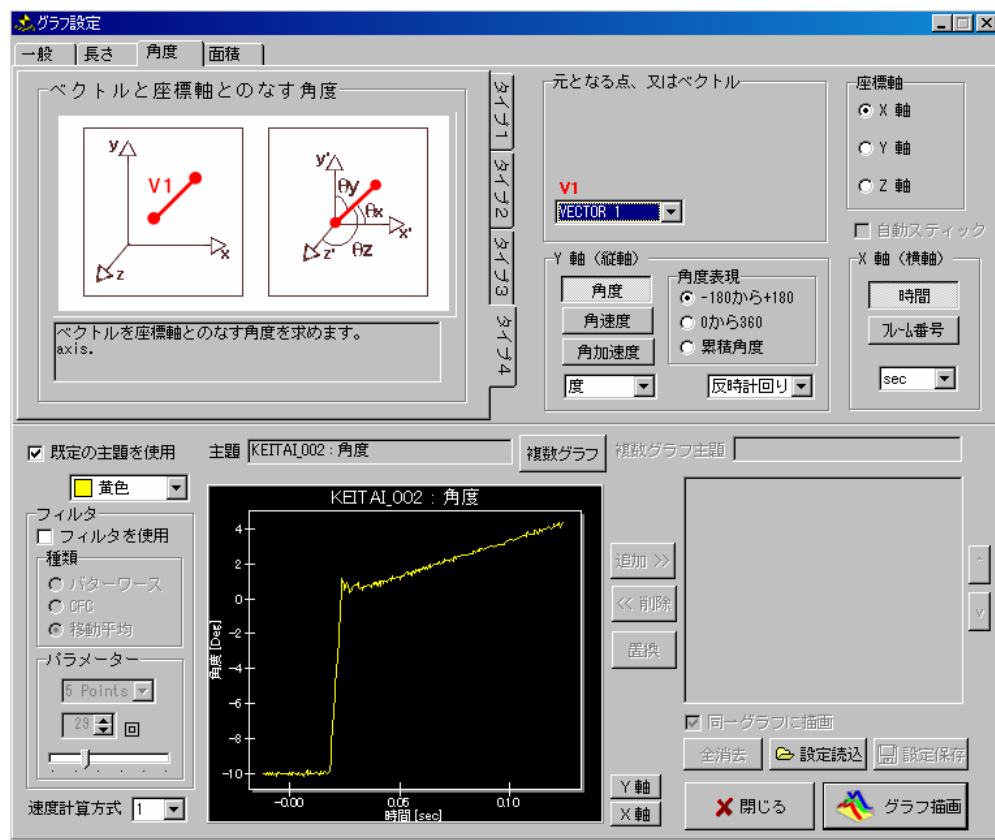


Figure 161 Type 4 Angle Settings Screen

Vectors are specified in the “Starting Points or Vectors” section of this screen to determine the angle. Otherwise, this is identical to that of Type 3.

4.5.4 Virtual Points

Virtual points or vectors created by combining tracking points. Other virtual points can be created by combining them with other previously created virtual points. The 9 types of virtual points include those from Type 1 to Type 9.

1) Type 1 Virtual Points

Type 1 Virtual Points (Figure 162) are points on a line connecting two tracking points P1 and P2. This virtual point is created by a coefficient of the numbers of the two points. The coefficient(k) is expressed as the distance from P1 to the virtual point (with 1 as the distance from P1 to P2).

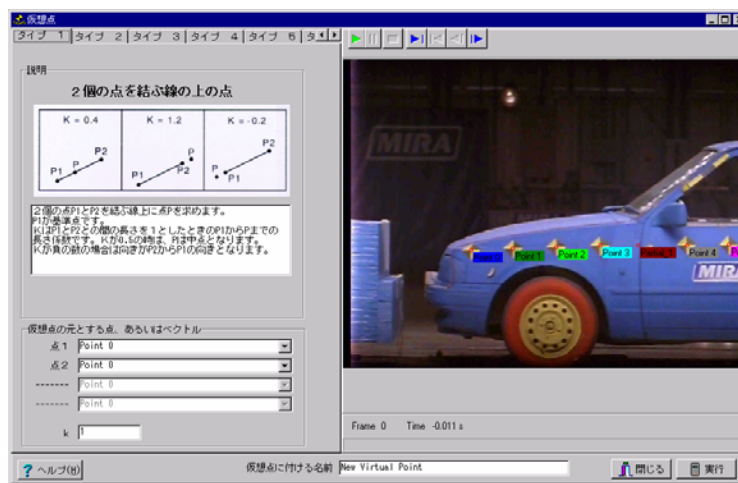


Figure 162 Type 1 Virtual Point Settings Screen

2) Type 2 Virtual Points

Type 2 virtual points (Figure 163) are created where P2 rotates around P1 within the surface created by P1, P2, and P3. With the rotation direction in the direction from P2 to P3, the rotation angle becomes the coefficient.

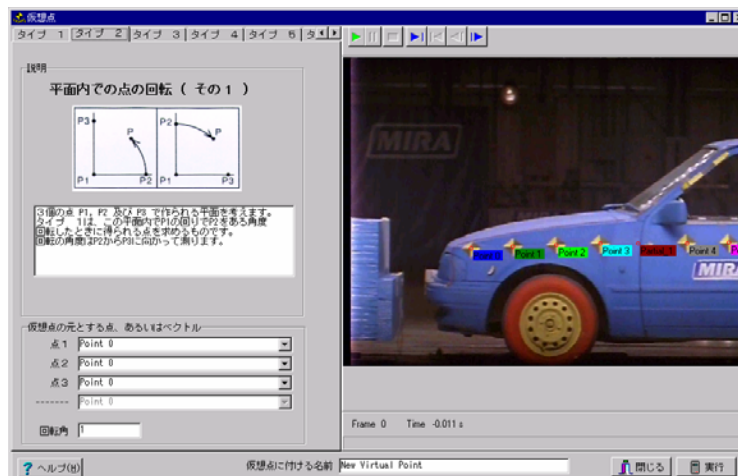
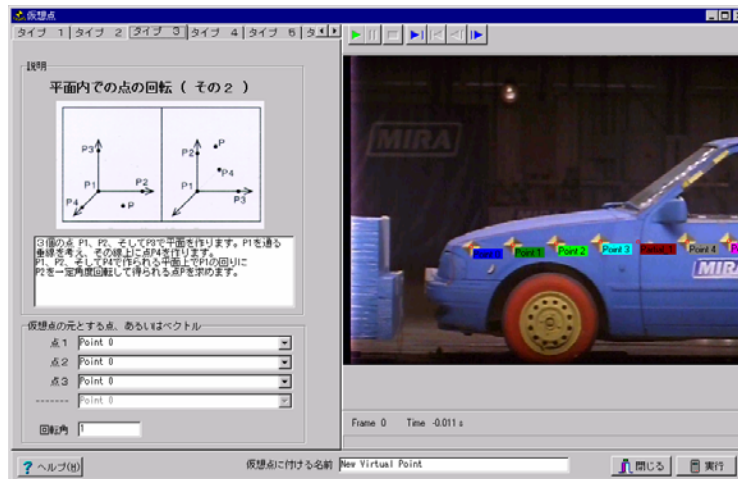


Figure 163 Type 2 Virtual Point Settings Screen

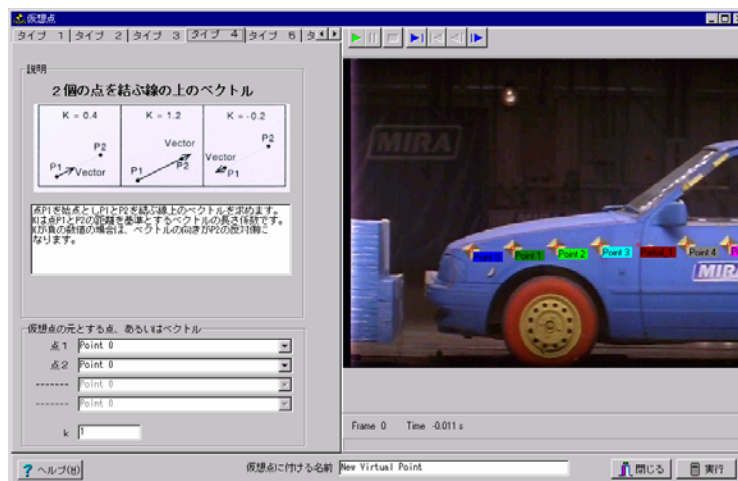
3) Type 3 Virtual Points

Type 3 virtual points (Figure 164) are created where P2 rotates around P1 within the surface created by P1, P2, and P4. With the rotation direction in the direction from P2 to P4, the rotation angle becomes the coefficient. P4 is on the line passing through P1 that is perpendicular to the surface formed by P1, P2, and P3. P4 is positioned on the right screw on P1 and is on the side that rotates around from P2 to P3.

**Figure 164 Type 3 Virtual Point Settings Screen**

4) Type 4 Virtual Points

Type 4 virtual points (Figure 165) are vectors with the ending point of the virtual point created in the same manner as that in Type 1 using P1 as the starting point

**Figure 165 Type 4 Virtual Point Settings Screen**

5) Type 5 Virtual Points

Type 5 virtual points (Figure 166) are vectors created from the sum of two vectors. When summing, a coefficient is applied to each vector.

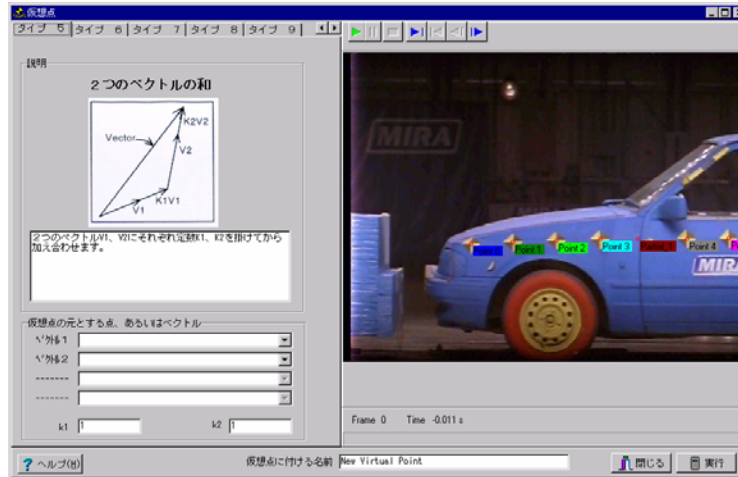


Figure 166 Type 5 Virtual Point Settings Screen

6) Type 6 Virtual Points

Type 6 virtual points (Figure 167) are points where one point is the starting point and one vector is the ending point. Coefficients can be applied to vectors.

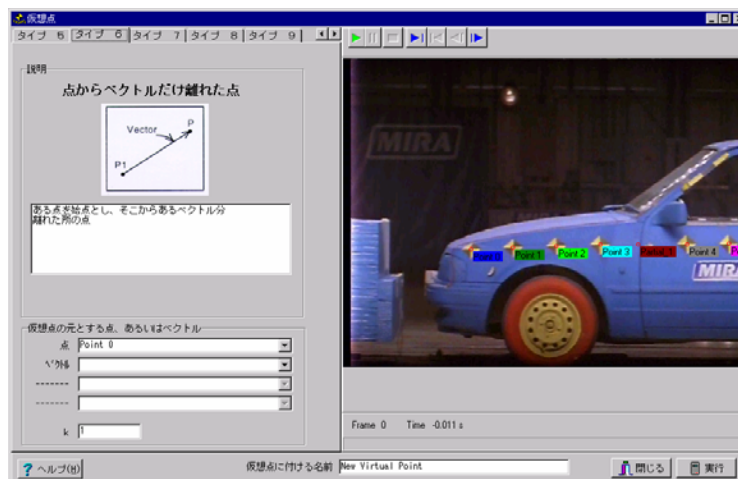


Figure 167 Type 6 Virtual Point Settings Screen

7) Type 7 Virtual Points

Type 7 virtual points (Figure 168) are unit vectors in the direction of each coordinate axis.



Figure 168 Type 7 Virtual Point Settings Screen

8) Type 8 Virtual Points

Type 8 virtual points (Figure 169) are unit vectors on lines connecting two points.

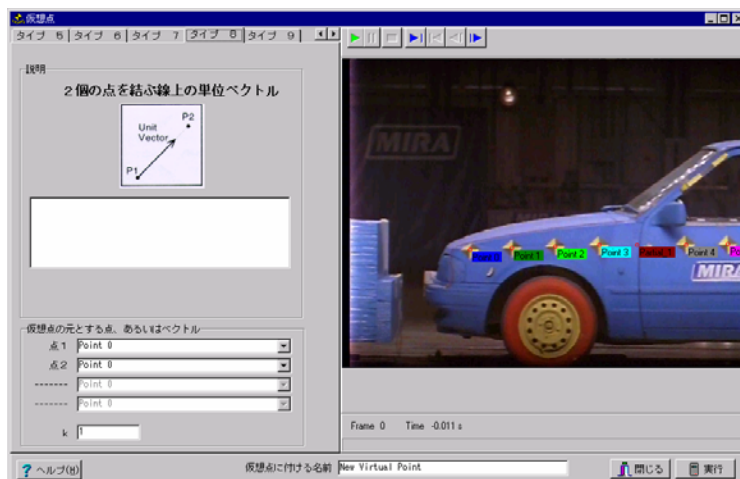


Figure 169 Type 8 Virtual Point Settings Screen

9) Type 9 Virtual Points

Type 9 virtual points (Figure 170) are element vectors of a given vector.

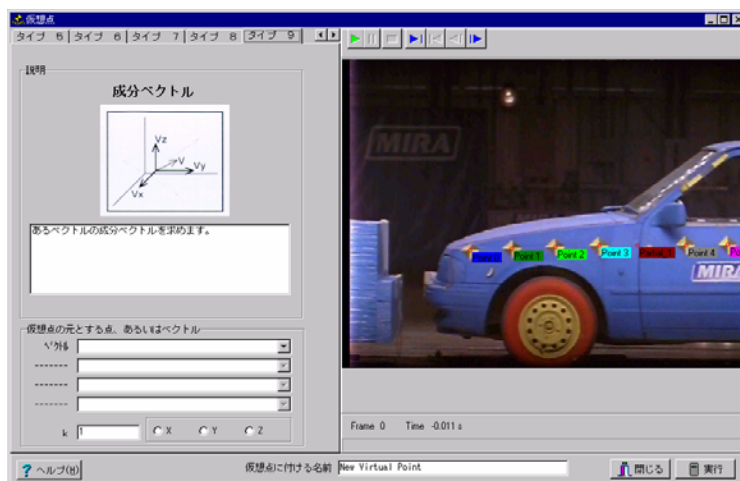


Figure 170 Type 9 Virtual Point Settings Screen

4.5.5 Mass

The mass of each point on the screen shown in Figure 171 is set in kilograms. Mass is used in calculations of kinetic volume, energy and center of gravity.

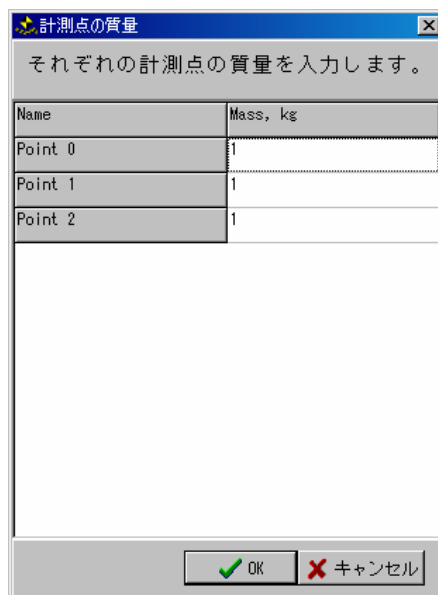


Figure 171 Mass Settings Screen for Measurement Points

4.5.6 Area Center of Gravity

The area center of gravity is a center of gravity for a combination of multiple points. The mass of these points was set previously in エラー! 参照元が見つかりません。 .

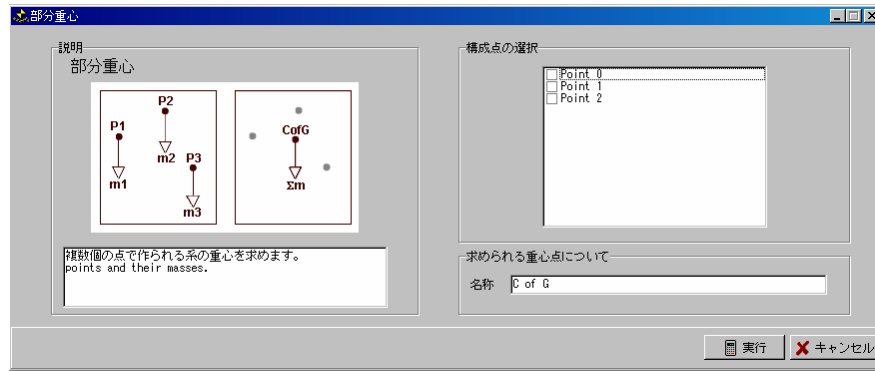


Figure 172 Area Center of Gravity Settings Screen

Check the relevant points on the screen in Figure 172 to select. Specify the name of the center of gravity point. Click “Execute” to calculate the center of gravity point and to display the data tree. The AVI drawing will be displayed in the same manner as standard points so the results can be graphed.

Calculation Example: The area center of gravity is calculated for points P1, P3, P6 and P7 as follows.

$$G_x = \frac{m_1 \times P_{1x} + m_3 \times P_{3x} + m_6 \times P_{6x} + m_7 \times P_{7x}}{m_1 + m_3 + m_6 + m_7}$$

$$G_y = \frac{m_1 \times P_{1y} + m_3 \times P_{3y} + m_6 \times P_{6y} + m_7 \times P_{7y}}{m_1 + m_3 + m_6 + m_7}$$

$$G_z = \frac{m_1 \times P_{1z} + m_3 \times P_{3z} + m_6 \times P_{6z} + m_7 \times P_{7z}}{m_1 + m_3 + m_6 + m_7}$$

Here, m_1 , m_3 , m_6 and m_7 are the mass for points P1, P3, P6 and P7.

4.5.7 Model Application

Refer to “エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。” for models and model defined ASCII files.

1) Reading Model Defined ASCII Files

After selecting a sequence, select the “Model Applications” menu. The screen in Figure 173 will be displayed.

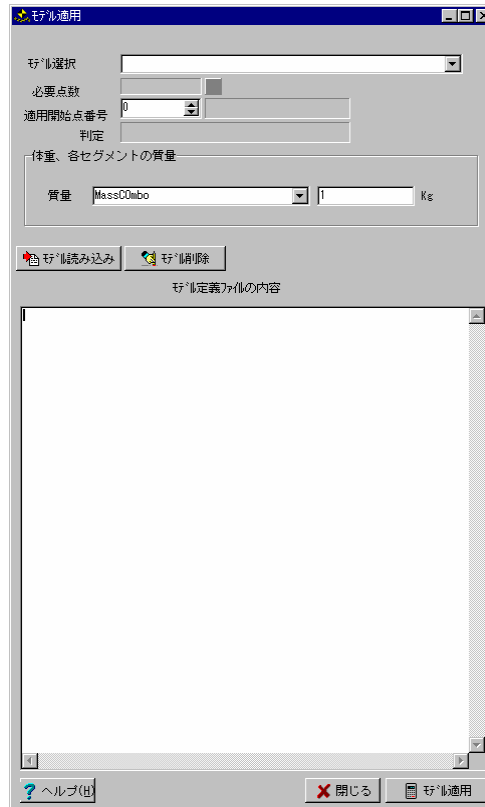


Figure 173 Reading Model Defined ASCII Files

Click “Read Model” on this screen. The screen in Figure 174 will be displayed.

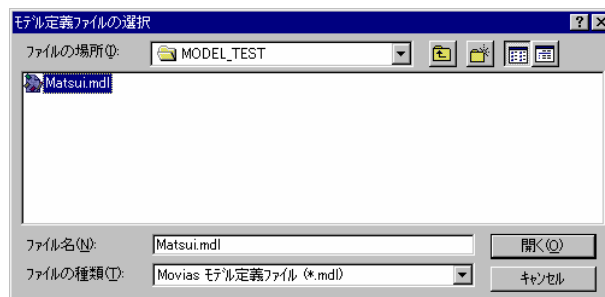


Figure 174 Model Defined ASCII File Settings

Specify the model defined ASCII file to be read using this screen. The screen in Figure 175 will be displayed.

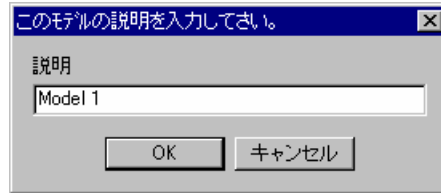


Figure 175 Assign Name to Model

Specify a name to be assigned to the model. Use a name that easily identifies the model.

Repeat this to read multiple models.

2) Applying Models to Sequences

First, select the model to apply to a sequence in the “Select Model” section. If the model selected can be applied to a sequence, “Model Application Possible” will be displayed in the verdict section. Click on “Apply Model” at the bottom right and a new sequence will be created from those results.

If the tracking points are insufficient, a message stating “The number of points are insufficient for applying to a model” will be displayed in the verdict section as the model selected cannot be applied.

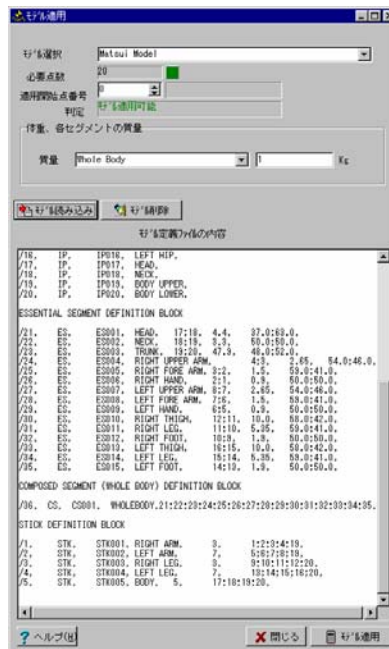


Figure 176 Applying Models to Sequences

4.6 Menu to Convert Coordinates

In the “Convert Coordinates” menu, new coordinates can be determined using tracking points and coordinates for points can be corrected with calculations based on these. Use one of the tracking points as the new coordinate starting point, or use two tracking points to determine the X and Y coordinate axis.

As demonstrated below, the settings for these new coordinates are particularly effective when determining the motion of an area different from the area in motion.

- Manequin motion relative to the vehicle for automobile crash tests
- Movement of another area of the body relative to the hips
- Mechanical movement on a vibrating table
- Elimination of camera movement during photography

This “Convert Coordinates” menu is also used for changing time data and displacement data standards.

4.6.1 Specifying the Starting Point

Select the “Specify Starting Point” menu and the screen in Figure 177 will be displayed. This screen is a section of the “Starting Point and Axis” tab on the 2-dimensional calibration screen.

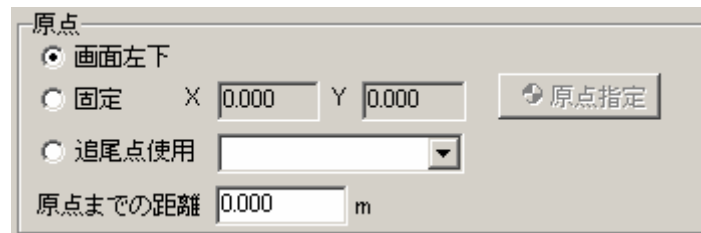



Figure 177 Screen to Specify the Coordinate Starting Point

- Check “Bottom Left of Screen” and the starting point will become the bottom left corner of the screen.
(In the File-Settings menu, if the upper left is selected as the default starting point, this will be at the upper left of the screen.)
- Check “Fix” to set a particular location on the screen as the starting point. After clicking on “Specify Starting Point” click on the location on the screen that will be the starting point.
The area clicked will be enlarged for display so drag the mouse so the × mark is exactly aligned for the starting point and then click the confirm button .



- Check “Use Tracking Points” to specify the tracking point as the starting point and specify the point to be the starting point.

4.6.2 Specify the Coordinate Axis

The direction of the coordinate axis can be designated with the Specify the Coordinate Axis menu. Select the “Specify the Coordinate Axis” menu and the screen in Figure 178 will be displayed. This screen is a section of the “Starting Point and Axis” tab on the 2-dimensional calibration screen.



Figure 178 Coordinate Axis Settings Screen

- Check “Right Facing Horizon” and vertical and horizontal lines on the screen will become the coordinate axis (the direction of the axis is to the right).
- To arbitrarily set the direction of the coordinate axis, set the position of two points on the screen. A line will connect these two points and the parallel line will become the coordinate axis. The direction is from the first point to the second point. First check “Fix”. After clicking on “Specify Position” click on the first point (starting point) on the screen. The area clicked will be enlarged for display so drag the mouse so the \times mark is exactly aligned for the starting point and then click the confirm button . Next, click on the location for the second point in the same manner to precisely align it and then click the confirm button .
- Check “Use Tracking Points” to specify the tracking point as the starting point and specify the second point to be the axis.
- Select the direction of the Y axis.

4.6.3 2-dimensional Calibration

1) Operating Procedures

Use this menu to implement “2-dimensional Calibration” to set and correct the standard length.

Select this menu to display the screen in Figure 179.

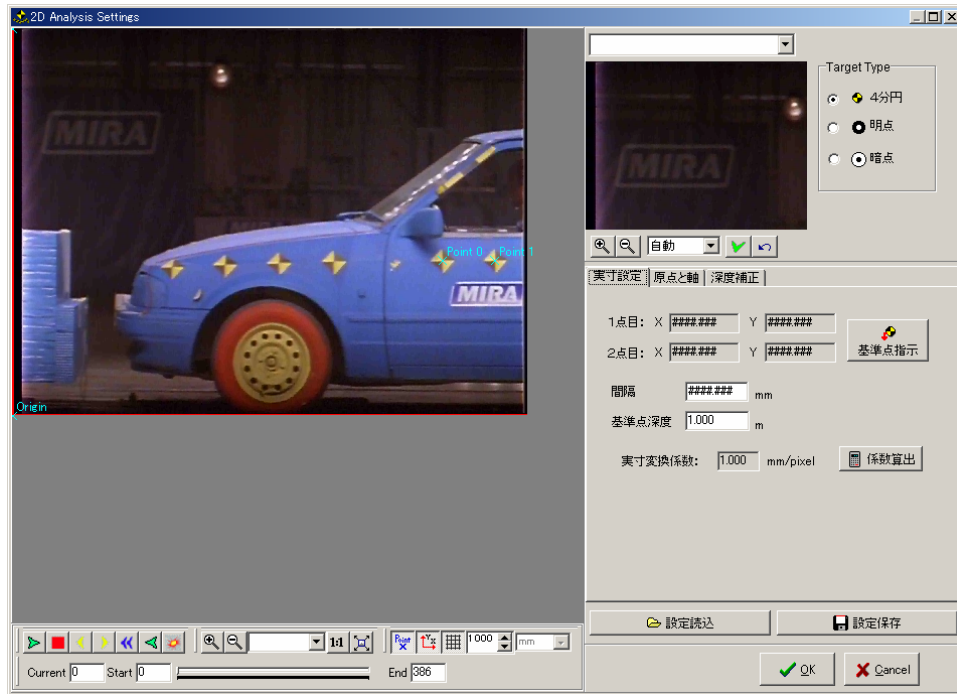


Figure 179 2-dimensional Calibration

First, use the frame playback control button at the bottom left of the screen to display the frame of the two points that will be the standard.

The standard length is set according to the following procedure.

- 1-1) Use the Specify Mark Type block in the upper right of the screen (Figure 180) to select the type of mark to be used as the standard point. Select “Do Not Specify” for those other than 4-quarter, solid and shaded marks.



Figure 180 Specify Mark Type block

1-2) Click “Specify Standard Point”.

1-3) The cursor will be arrow shaped and the label Mark1 will be attached.

In the image, click close to the center of the first point to be the standard point.



Figure 181 Calibration 1st Point

The automatic detection results for the center of the mark will be displayed in the zoom window on the right side. Operation is as follows.

- If there is no problem with detecting the center
Proceed to specify the 2nd point.
- If there are problems detecting the center
Drag the × mark indicating the center position to near the center and click on the magnet button (🧲) to perform automatic detection of the center again. Once the center is detected properly, click Verify (✅) and proceed to specify the 2nd point.
If the center is still not detected correctly, drag the × mark to the center and click Verify (✅) and then proceed to specify the 2nd point.

1-4) Next, click in the vicinity of the center of the 2nd point.

Verify or correct the center detection results in the same manner as with the 1st point.

1-5) In the interval section, input the actual dimensions between the two points in mm units.

1-6) If conducting depth correction
In the standard point depth section, input the distance (photographic distance) from these two points to the camera in m units.
If not conducting depth correction, leave as 1.

1-7) Click “Calculate Coefficient”.

The conversion coefficient for actual dimensions will be displayed.

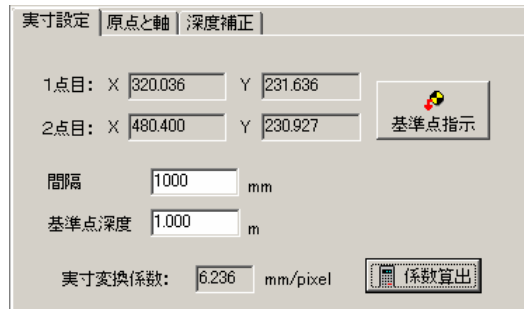


Figure 182 Screen when Calibration is Complete

1-8) Click “OK”.

2) Center Detection Parameters

Various center detection parameters are used for center mark detection. The parameters used those saved as defaults in the automatic tracking section. (If the parameters in the automatic tracking section are not changed, the system default parameters are used.) If the center mark cannot be properly detected even when there are no problems with the image, modify the parameters in the tracking screen and save the results as defaults.

4.6.4 Mirror Image

Click on the “Mirror Image” menu to invert the X coordinates. The video image will also be reversed left/right. Click again to revert to the original.

4.6.5 Specify Time Standards

This is an operation to change the To frame that is the starting point for time and is performed on the “Tracking - Editing” screen.

4.6.6 Specify Displacement Standards

Select the “Specify Displacement Standards” menu to display the screen in Figure 183.

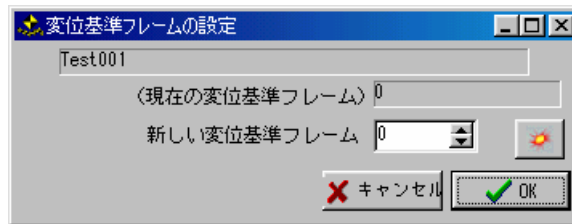


Figure 183 Screen to Specify Displacement Standards

Input the frame number that will become the new displacement standard and click “OK”.

Click  and the frame currently displayed becomes the new displacement standard.

4.7 Tools Menu

4.7.1 Tracking - Editing

Automatic tracking is performed here and the tracking results can be edited.
Refer to “5Tracking Window” for details.

4.7.2 Stick Definitions

Stick figure definitions are located here. Stick figures (Figure 184) are defined as lines connecting two or more tracking points. Stick figures are superimposed on AVI images.

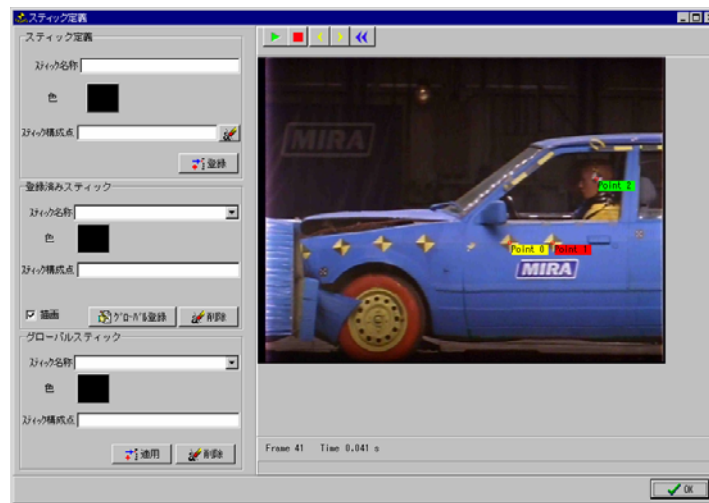


Figure 184 Entire Screen for Stick Definitions

1) Stick Definitions and Entry

Stick figure definitions are conducted in the “Stick Definitions” section at the top left of the screen. (Figure 185).

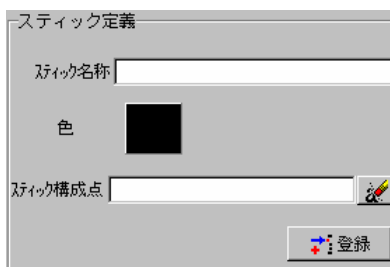




Figure 185 Stick Definition Section

First, input the name of the stick to be defined in the Stick Title section.
Next, double click on the color section to set the stick color.
Then display the frame that is suitable for defining sticks and click in order of the labels for the points forming the sticks (section displaying Point 0).

Numbers of the points forming the sticks are punctuated by commas. Instead of clicking on points inside the image, commas can be input to punctuate the numbers of the points. For example, if defining sticks connecting the 4 points of 2, 5, 8, 9, input 2,5,8,9.

If an error is made in specifying the numbers of the points, click  on the right side, delete the numbers of the input points and re-enter them. Once this is complete, click “Enter”. Repeat this for the required number of sticks.

Sticks entered will be displayed in the section “Entered Sticks” (Figure 186). Since the entered sticks are displayed, sticks can be replaced with  as necessary.

Click “Global Entry” and the sticks currently displayed will be entered as global sticks.

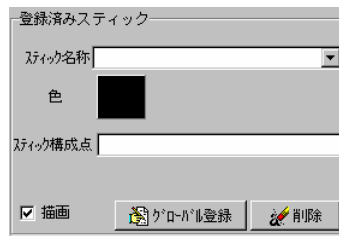


Figure 186 Entered Stick Section

2) Global Stick

If sticks defined by sequences are globally saved, they can be used in other sequences. (Figure 187) To apply a stick saved globally to a sequence, select the applicable global stick and press “Apply”.



Figure 187 Global Stick Section

Important : Tracking points forming sticks are identified by the point number. If applying global stick, and if a tracking point with the same number and order as when it was defined is not in the sequence, this will generate an error.

3) 3D Sequence Sticks

If displaying sticks with 3D analysis, start with a 3D structure and define the sticks during the 2D stage. Sticks defined in 2D can be moved to initially formed 3D sequences.

4.7.3 Optical Distortion Correction/SAE Chart Measurement

Select “Optical Distortion Correction/SAE Chart Measurement” from the “Tools” menu to display the screen in Figure 188.

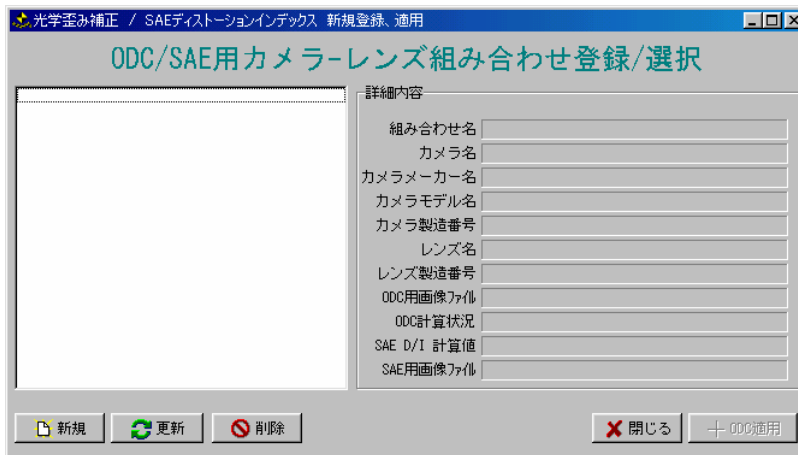


Figure 188 Initial Screen for Optical Distortion Correction/SAE Chart Measurement

Click “New”. The screen in Figure 189 will be displayed.

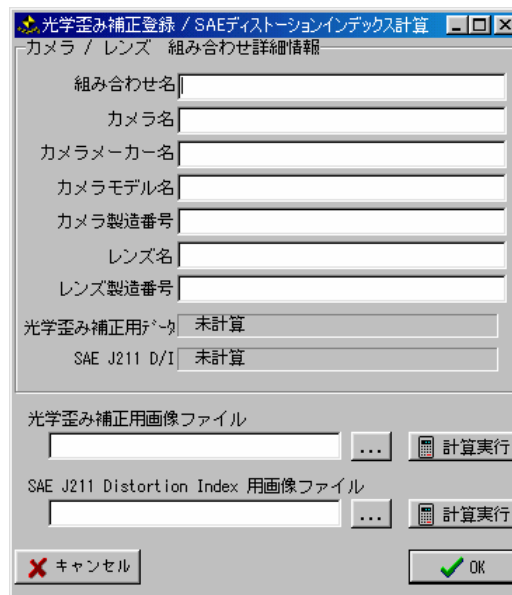




Figure 189 Name Combination Attribute Settings and Specifying Files

The following can be performed on this screen.

- Name Combinations

Input the name specifying the combinations of cameras and lenses that photographed images to be measured (identifying name). Name combinations must be input.

- Items from Camera Names to Lens Production Number
Input items from the camera names to the lens production number. Input is not essential but since this is the basis for specifically determining what camera and lens combination is involved, it should be input.
- Data for Correcting Optical Distortion
Shows whether or not data for correcting optical distortion has been calculated.
- SAE J211 D/I
This value is displayed when distortion index calculation is conducted with SAE J211. This is not essential.
- Image Files for Correcting Optical Distortion
Press  to select the image file (TIFF image file) where images photographed of the chart for correcting optical distortion are recorded with the combination of these cameras and lenses. Press “Calculate” to measure data for correcting optical distortion using the image file (1).
- Image File for SAE J211 Distortion Index
Press  to select the image file (AVI file) where the image for calculating the SAE J211 Distortion Index photographed with this combination of cameras and lenses is recorded. Press “Calculate” to measure the distortion index data using the image file (0).

1) Measuring Optical Distortion Correction Data

Figure 190 is displayed next. Click “Specify Four Corners”.

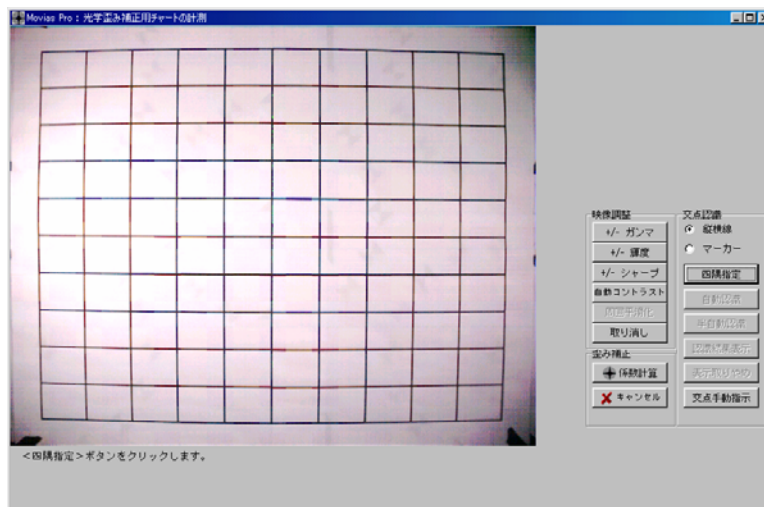


Figure 190 Specify Four Corners

A dialogue box stating “Click on the Upper Left Corner of the Image” will appear. Click on the upper left corner of the chart in the image. The borders

of the section clicked will be enlarged and the screen in Figure 191 will be displayed.



Figure 191 Closeup of Upper Left Corner

In the enlarged image displayed at the upper right of the screen, right click the mouse on the corner and then click on “Verify Intersection”. If the position displayed in the enlarged image is not correct, drag with the left mouse button to adjust.

Specify the upper right, bottom left and bottom right corners in the same manner.

After specifying the corner has been completed, click “Semi-automatic Identification”. The dialogue box in Figure 192 will be displayed.



Figure 192 Dialogue Box for Specifying Grid Lines

Use this dialogue box to input horizontal and vertical lines to create a chart and then click “OK”. Conduct semi-automatic identification of the intersection and the screen in Figure 193 will appear.

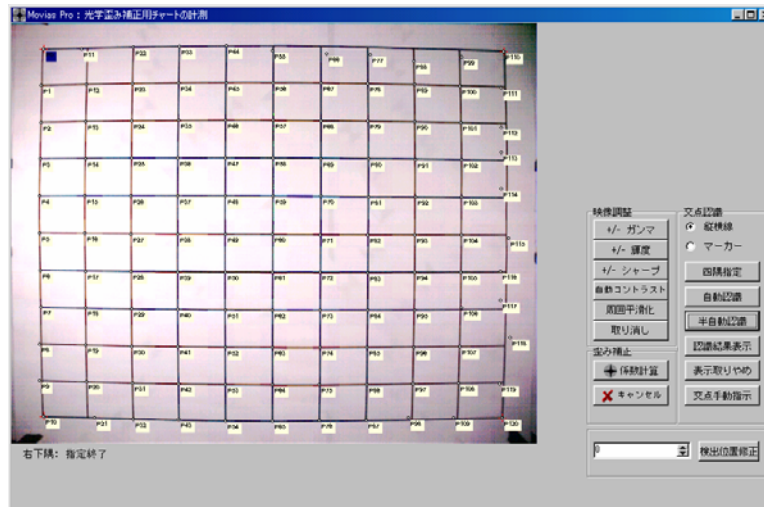


Figure 193 Results of Semi-automatic Identification of Intersection

View this screen and determine if there are any errors in identifying the intersections.

If there are no errors and all of the intersections are properly identified, click “Calculate Coefficient” to complete the identification process for the intersections.

If there are errors and there are intersections that are not properly identified, first manually correct the errors. The procedure for correcting errors is as follows.

- Use the mouse to click on the small circle corresponding to the intersection with the error in the image of identification results.
- The section clicked will be displayed as an enlarged image to the top right. Right click at the intersection in the same manner as when inputting the corners and then click “Verify Intersection”.
- Repeat this for all of the intersections with errors.

After correcting all of the errors, click “Calculate Coefficient”. The screen in Figure 194 will reappear. Click “OK” to finish.

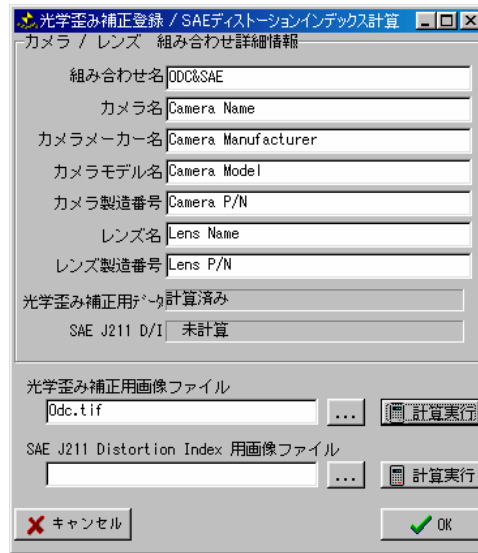


Figure 194 Screen to Finish Correction of Optical Distortion

- 2) Measurement of Distortion Index (SAE J211/2 standards REV.MAR95)

Figure 195 is shown next.



Figure 195 Initial Screen for Measurement of Distortion Index

Click “Measure” after selecting “Semi-Automatic”. Continue to Figure 196.



Figure 196 Indicate the Center of the Circle

Sequentially click on the mark in the center of the 5 circles on this screen. A message will appear on the bottom of the screen to click on the center of the circles at the upper left, upper right, lower left, lower right and center. Once the centers of the 5 circles are specified, mark detection is automatically conducted.

Since the center might not be detected properly or there might be a problem with mark detection, a small cross will be displayed in the location detected as the center mark and the screen shown in Figure 197 will be displayed.

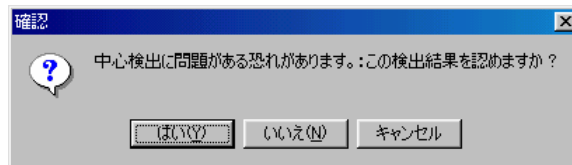


Figure 197 Potential Problems with Detecting the Centers

View the cross displayed and

- If the location of the cross is in the center, click “Yes”.
- If the location of the cross is not in the center, click “No” and manually click on the center mark with the cursor.

The Distortion Index is calculated once center mark detection has been completed and Figure 198 will be displayed.



Figure 198 Distortion Index Measurement Completed

4.8 Help Menu

4.8.1 Sample Mark for Printing

Open the pdf file of the sample mark for printing.

Adobe(R) Reader is required.

Refer to the Adobe website <http://www.adobe.co.jp/> for details.

4.8.2 User's Manual

Open the pdf file for this user's manual.

Adobe(R) Reader is required.

Refer to the Adobe website <http://www.adobe.co.jp/> for details.

4.8.3 Version

Information on the version will be displayed.

4.9 Data Tree Right Click Menu

Right click on the items displayed on the data tree to delete or change the display color of the tracking points.

Since only some operations can be conducted by right clicking, they are described here. Please review the descriptions on the related pages for operations from the main menu.

4.9.1 Project Right Click Menu

Right click on the project on the data tree and the popup menu in Figure 199 will be displayed.

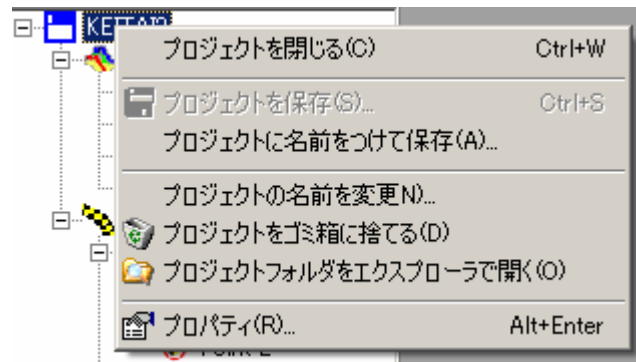


Figure 199 Project Right Click Menu

Click “Close Project” to close a project.(4.2.3 Close Project→page 84)

Click “Save Project” to save a project.(4.2.4 Save Project→page 84)

Click “Save Project As” to save a project under a different name. (4.2.5 Save Project As→page 84)

Click “Change Project Name” to change the name of a project. (4.2.7 Change Project Name→page 85)

Click “Delete Project” to open the following confirmation screen. If “Yes”, any unwanted projects can be sent to the Explorer trash bin. Use caution when moving all project files, including analytical results and original image files to the trash bin.



Figure 200 Deleting Projects (Confirmation Screen)

Click “Open Project in Explorer” to open a previously saved project in Explorer.

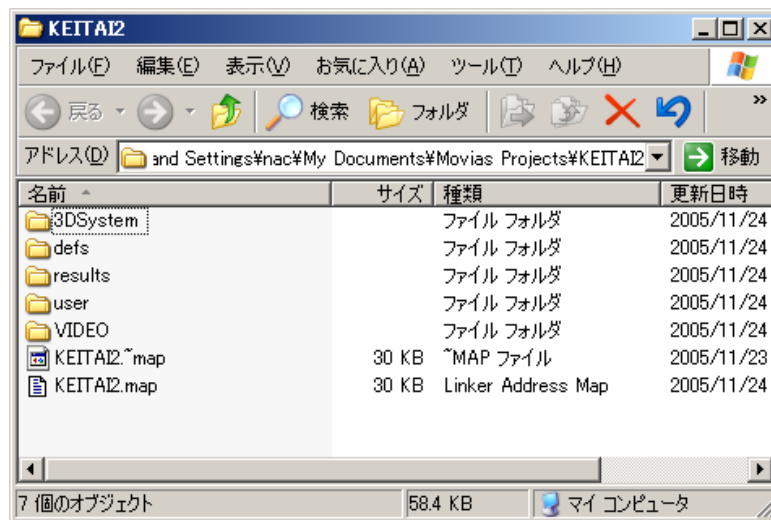


Figure 201 Open Project in Explorer

Click “Properties” to display the project information in Figure 202.



Figure 202 Project Information

4.9.2 Sequence Right Click Menu

Right click Sequence on the data tree to display the popup menu in Figure 203.

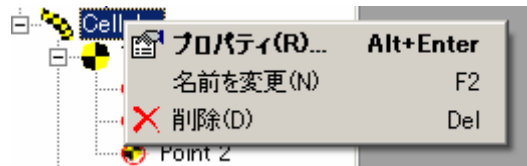


Figure 203 Sequence Right Click

Click “Properties” to display the sequence properties shown in Figure 204.

Click “Change Name” to change the sequence name.

Click “Delete” to delete the sequence.

Use caution since it cannot be recovered.

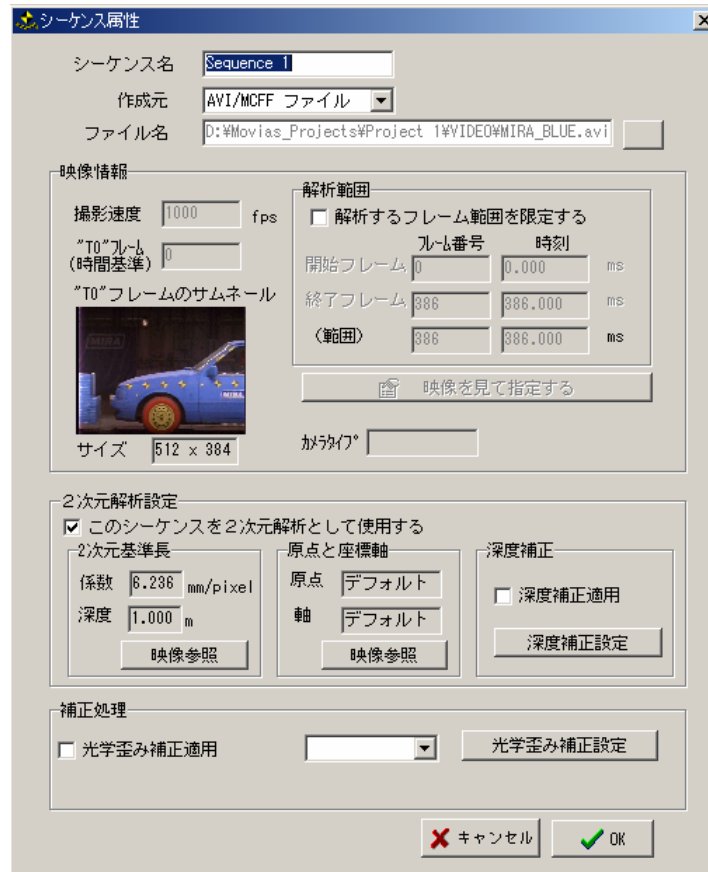


Figure 204 Sequence Properties

4.9.3 Right Click Menu for Tracking Points

Right click the tracking points on the data tree to display the popup menu in Figure 205.

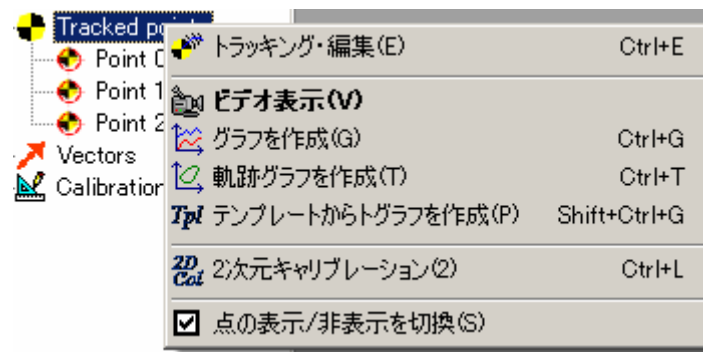


Figure 205 Tracking Points Right Click

Click “Tracking-Editing” to open the tracking screen again. Add or edit tracking points (correct results) here. (5 Tracking Window→page 191)

Click “Display Video” to display the video. (エラー! 参照元が見つかりません。→page エラー! ブックマークが定義されていません。)

Click “Create Graph” to create a graph of the selected sequence. (エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。→page エラー! ブックマークが定義されていません。)

Click “Create Trajectory Graph” to create a trajectory graph of the selected sequence. (エラー! 参照元が見つかりません。エラー! 参照元が見つかりません。→page エラー! ブックマークが定義されていません。)

Click “Create Graph From a Template” to create a template graph of the selected sequence. (4.4.4 Graph→page 149)

Click “2-dimensional Calibration” to display 2-dimensional calibration information for the selected sequence. (4.6.3 2-dimensional Calibration → page 168)

Click “Switch Display/Do Not Display Points” and the screen in Figure 206 will be displayed. Check the points to be displayed when displaying points in a trajectory figure or video display or remove checks when not displaying points.

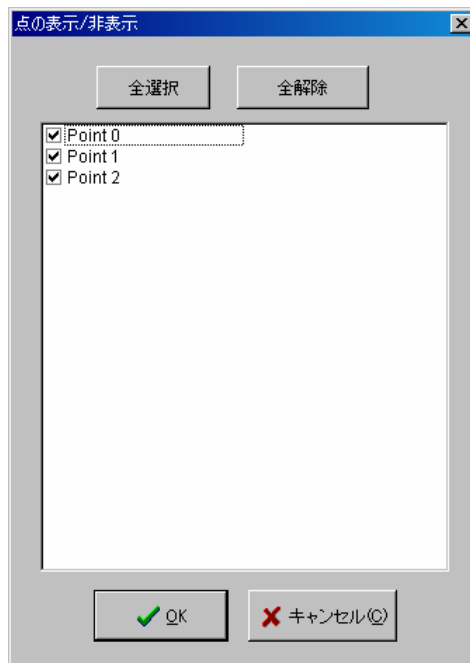


Figure 206 Display/Do Not Display Points

4.9.4 Right Click Menu for Individual Tracking Points

Right click on Points on the data tree to display the popup menu in Figure 207.

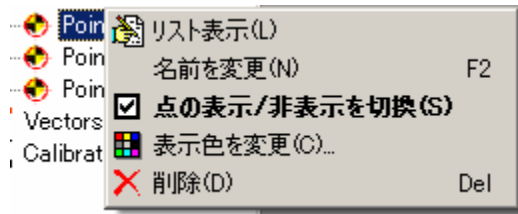


Figure 207 Tracking Points Right Click

Click “List Display” and the list display of analysis results will be displayed. (Graph List Display→page 143)

Click “Change Name” to change the name of the tracking points.

“Switch Display/Do Not Display Points” is identical to that of the tracking points above. (→Figure 206)

Click “Change Display Color” to change the color of the point displayed on the video display.

Click “Delete” to delete the sequence of these tracking points. Use caution since deleted points cannot be recovered.

4.9.5 Graphs

Right click on a graph entered in the Results in the data tree and the popup menu in Figure 208 will be displayed.



Figure 208 Graph Results Right Click

Click “Display” to show the graph entered. (→エラー! ブックマークが定義されていません。 page)

Click “Delete” to delete the graph entered.

4.9.6 Optical Distortion Correction

Click ODC on the data tree to display the popup menu in Figure 209.



Figure 209 Optical Distortion Correction Right Click

Click “Apply” and optical distortion correction will be applied to this sequence.

Click “Delete” and the optical distortion correction applied to this sequence will be deleted.

5. Tracking Window

5.1 Explanation of Tracking Window Buttons

This chapter explains the buttons in the tracking window.

The tracking window is divided into the 7 sections shown in Figure 210. An explanation for the buttons in each section is given here. There are no buttons in the Video View and Message Display sections to explain.

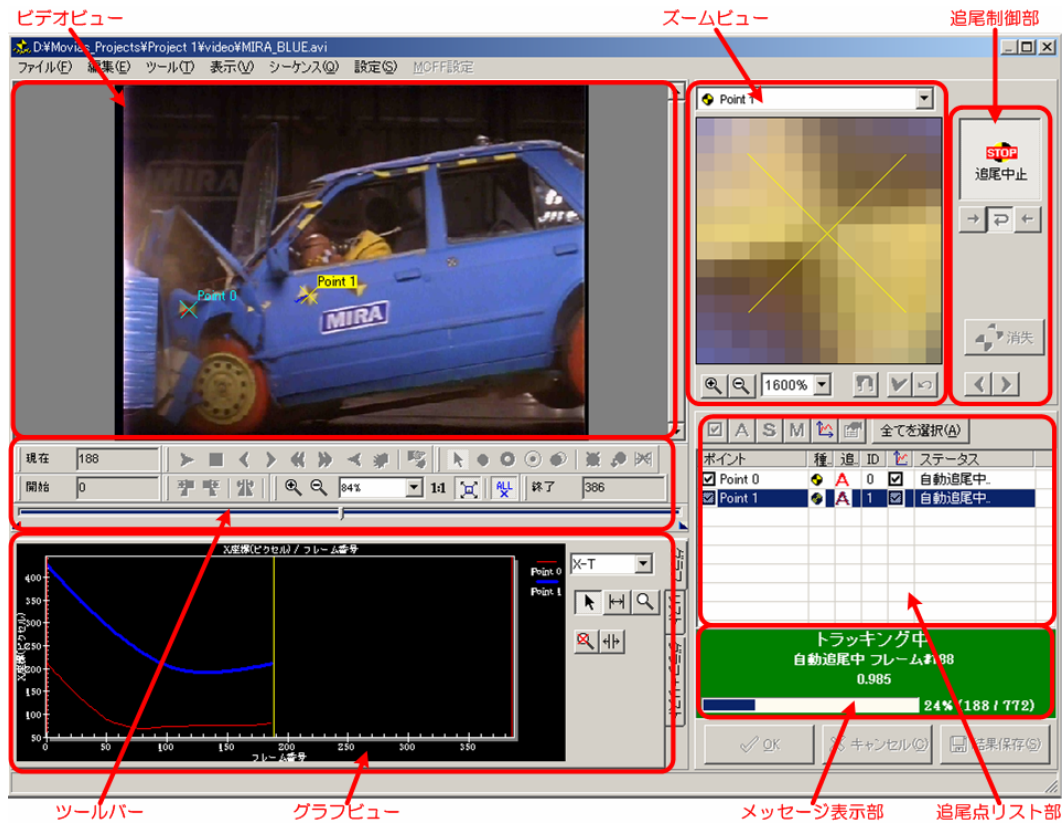


Figure 210 Sections of the Tracking Window

1) Toolbar

The toolbar includes the sections shown in Figure 211.

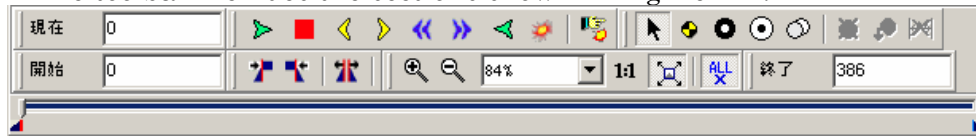


Figure 211 Toolbar

- : Displays the frame number of the current frame.
Input a number here to change the current frame.
- : Displays the beginning frame number of the selected range.
Input a number here to change the beginning frame.
- : Displays the ending frame number of the selected range.
Input a number here to change the ending frame.
- : Plays back the video file (AVI file, MCFF file) forward or in reverse.
- : Frame by frame playback of the video file forward or in reverse.
- : Jumps the current frame to the one immediately before or after. The jump frame must be either the first/last frame of the video file or the beginning/ending frame of the selected range.
- : Jumps to the T0 frame as the current frame.
- : Sets the current frame as the To frame.
- : Changes to the point selection mode.
- : Changes to the mode to add 4-quarter targets.
- : Changes to the mode to add solid targets.
- : Changes to the mode to add shaded targets.
- : Changes to the mode to add correlation targets.
- : Deletes the (selected) targets.
- : Sets the position of the target (when tracking again after deleting).
- : Deletes the (selected) targets within the current selected range.
- : Changes the current frames to the beginning frame of the selected range.
- : Changes the current frames to the ending frame of the selected range.
- : Deletes the selected range.
- : Enlarged/reduced display of the image.
- : Displays 1:1 sizing of the image. (pixels)
- : Displays the image in exactly the same size as the Video View.
- : Switches between display all of the tracking points in the video view and display of only the selected points.

2) Graph View

Graph View includes the sections shown in Figure 212.

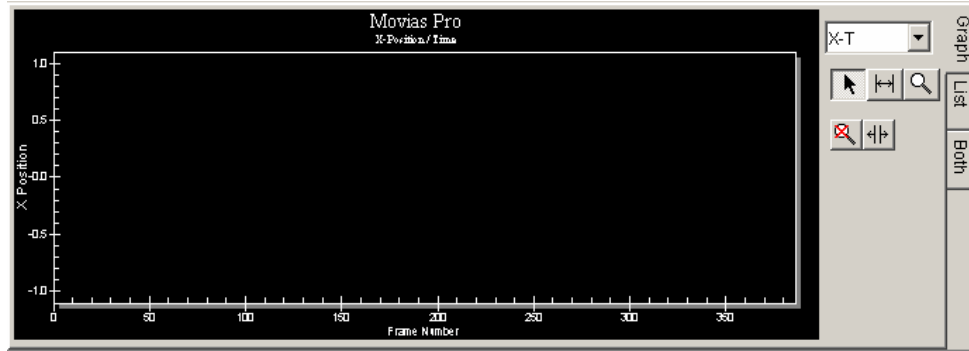


Figure 212 Graph View



: Select the type of graph.

X-T: plays a graph of the X coordinates for the frame number.

Y-T: Displays a graph of the Y coordinates for the frame number.

XY-T: Displays a graph of the trajectory figure (horizontal axis is the X coordinates, vertical axis is the Y coordinates)

Complete tracking: Displays the tracking location for each target.

Incomplete tracking: Displays the tracking location or deleted location for each target.



: Moves the current frame. If clicked inside a graph while this button is pressed, the current frame moves to the location clicked.



: Designates the selected range. If dragged inside a graph while this button is pressed, the dragged range becomes the selected range.



: Zooms the graph display. If dragged inside a graph while this button is pressed, the dragged range becomes the selected range.



: Resets the zoom display and displays the entire object.



: Resets the selected range and sets the entire object as the selected range.

3) Zoom View

Zoom view includes the sections shown in Figure 213.



Figure 213 Zoom View



: Enlarged/reduced display of the image.



: Automatic centering toolbar button. Press this button to automatically view the center of the target and move to that point.



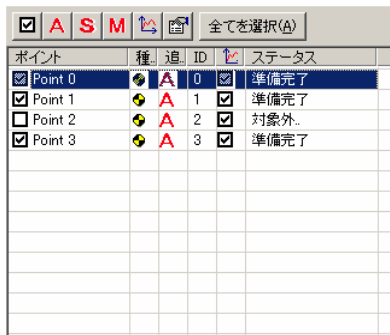
: Verification button to indicate if the operation has been completed, such as when designating the center of a target or interrupting tracking.



: Button to return to the original operation when changing the location of the center of the target.


4) Tracking Point List

The tracking point list includes the sections in Figure 214.



ポイント	種	ID	ステータス
<input checked="" type="checkbox"/> Point 0	A	0	準備完了
<input checked="" type="checkbox"/> Point 1	A	1	準備完了
<input type="checkbox"/> Point 2	A	2	対象外
<input checked="" type="checkbox"/> Point 3	A	3	準備完了


Figure 214 Tracking Point List


: Click this button after selecting a target to switch between track/do not track the target.

A: Changes the tracking method to automatic tracking (auto).

S: Changes the tracking method to semiautomatic tracking (semi-auto).

M: Changes the tracking method to manual tracking.

: Click this button after selecting a target to switch between display/do not display the tracking results.

 プロパティ(R): Opens the target property settings dialogue box.

全てを選択(A): Click this button to select all tracking points as a group.

5) Right Click Menus for Tracking Points on the Tracking Point List

Right click a tracking point on the tracking point list to open the screen in Figure 215.

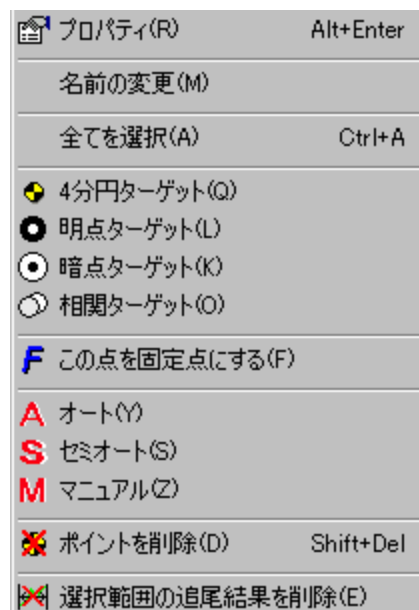




Figure 215 Right Click Menu for the Tracking Point List


This menu includes the following items.


 プロパティ(R) : Opens properties screen for the right clicked tracking points.


名前の変更(M) : Changes the name of the right clicked tracking points.

全てを選択(A) : Selects all of the points.


 4分円ターゲット(Q)


 明点ターゲット(L)


 暗点ターゲット(K)


 相関ターゲット(O)

: Changes the type of the right clicked tracking points.


 この点を固定点にする(F) : Changes the right clicked tracking points to stationary points.

 オート(Y)


 セミオート(S)

 マニュアル(M)

: Changes the tracking mode of the right clicked tracking points.

 ポイントを削除(D)

: Deletes the right clicked tracking points from the list.

 選択範囲の追尾結果を削除(E)

: Deletes the tracking results for the right clicked tracking points within the selected range.

5-1) Stationary Points

If desired, any location within an image can be made into a stationery (does not move) point. After being entered, it is handled in the same manner as other tracking points.

Stationary points have the following characteristics.

- Stationary points can be designated where there are no marks (4-quarter or solid).
- If the location of a stationary point in a given frame is changed, this change is applied to all of the frames.
- Stationary points cannot be deleted in a given section of a range.

5-2) Delete Tracking Results in a Selected Range

If delete tracking results in a selected range is specified, the screen in Figure 216 will be displayed.

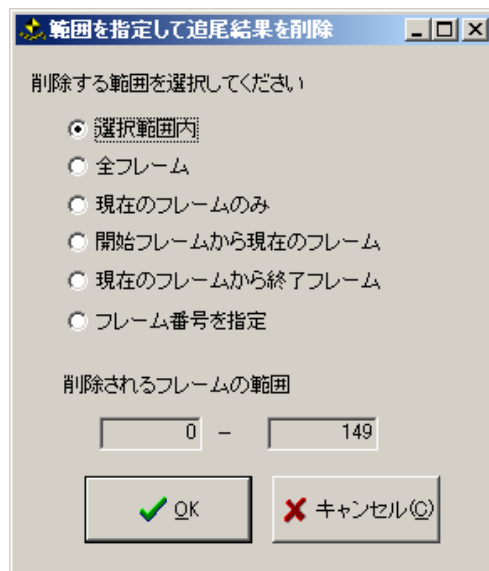


Figure 216 Delete Tracking Results in a Selected Range

The range for deletion is selected with this screen.

6) Tracking Controller

The tracking controller includes the sections in Figure 217.



Figure 217 Tracking Controller



: Click this button to start tracking with the set conditions.



: Click this button during tracking to interrupt tracking.



: Press this button for the tracking direction.



: Press this button for automatic reverse tracking.



: Press this button for reverse tracking.



: Use this for frame by frame image playback.



5.2 Other Operations


5.2.1 Specify Range

Specify range is used to designate the range of the frames to be tracked and is necessary to designate the range of frames to delete sections of tracked results and conduct additional tracking. It includes the following three methods.






- Method Designating Exact Frame Number

This method is useful when the starting and ending frame numbers of the range have been determined.

Input the starting frame number for the range using the current frame on the toolbar (). (Press Enter after input.) After the current frame moves to the starting frame of the range, click the range starting frame setting button (.


Input the ending frame of the range in the same manner and then click the range ending frame button (.

- Method of Specifying on a Graph #1



This method is useful when specifying a range while viewing the tracking status on a graph. Verify that the move current frame button ( in View Graph is pressed. If not, click it. Click on the location of the starting frame of the range on the graph. The location clicked becomes the current frame. (this can be clicked multiple times.) Use the frame by frame buttons (, ) on the toolbar to make minute adjustments to the current frame (to move multiple frames), Click on the range starting frame settings button ( to specify. In the same way, click on the location of the ending frame for the range and then click on the range ending frame settings button (.

- Method of Specifying on a Graph #2

This method is useful when specifying a range while viewing the tracking status on a graph.

Click on the select range settings button ( in View Graph. Drag from the range starting frame on the graph to the range ending frame.

5.2.2 Delete Range Specification

To delete a range specification (select the entire range), click on the delete range button ( on the toolbar. Deletion can also be conducted by clicking the delete range button ( in Graph View.

5.2.3 Display Tracking Window

If it becomes necessary to track new points after closing the tracking window when initially completing tracking, or if correcting the tracking results becomes necessary, the tracking window must be opened again. To open the tracking window again, double click or right click on Tracking Points in sequences on the data tree and select the “Tracking · Editing” menu displayed. (Figure 218) The tracking window can also be opened by selecting the Tracking-Editing” menu on the Tools menu.

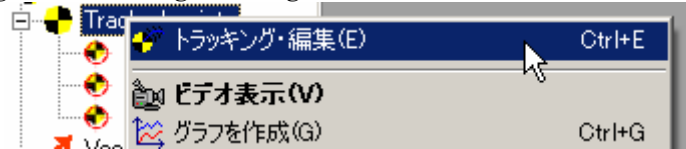


Figure 218 Tracking·Editing Menu

5.2.4 Selecting Targets

When performing any activity relating to targets in the tracking window, there may be occasions when it is necessary to select targets for the activity. Selecting targets is conducted in the following 4 manners.

- Click on the target mark (× or 田) displayed in Video View.
Targets selected will be shown in yellow (default).
- Click on the line corresponding to the selected target from those lines on the graph shown in Graph View. The line of the selected target will become thicker.
- Select from the list box (Point 0) in the Zoom View section.
- Click from the list of tracking points on the row with the selected target.

5.2.5 Deleting Targets

The following three methods exist to delete tracking targets.

- First, select the target to delete using the method described in エラー! 参照元が見つかりません。 . Then, select the delete menu for Editing – Points.
- First, select the target to delete using the method described in エラー! 参照元が見つかりません。 . Then click on the delete button (✖) for Toolbar points.
- Align the cursor with the target to be deleted from the list of tracking points and then right click. Then, click on the menu for deleting points.

5.2.6 Deleting Tracking Results by Specifying the Range

If the tracking results are partially wrong, they can be deleted and corrections can be made on only that section. This describes the method of deleting tracking results by specifying the range.


1) Ranges that Can Be Specified

The following 5 types can be designated as ranges to be deleted.

- Range between starting frame and ending frame
- All frames
- Current frame only
- Range from the starting frame to the current frame
- Range from the current frame to the ending frame

2) Deletion Method

The method for deleting tracking results by specifying the range is as follows.

- First, select the range to delete using the method described in エラー! 参照元が見つかりません。 .
Or adjust the current frame.
- Next, select the target to delete using the method described in エラー! 参照元が見つかりません。 .
- With either method, the screen in Figure 219 will be displayed.
 - 1) Select “Delete Tracking Results by Specifying the Range” from the Editing menu.
 - 2) Click on the “Delete Tracking Results by Specifying the Range” button () on the toolbar.
 - 3) Align the cursor with the target to be deleted from the list of tracking points and then right click. Then select the “Delete Tracking Results for the Selected Range” menu.
- Figure 219 will be displayed. Select the range to delete and click “OK”.

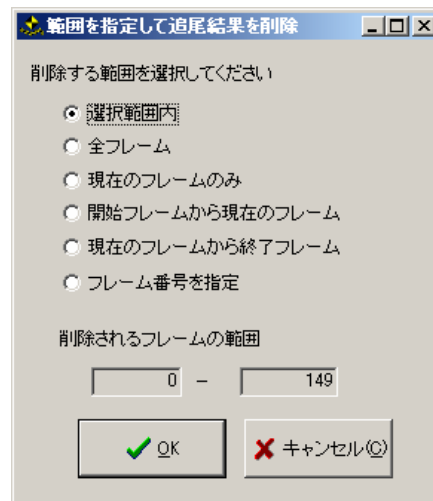


Figure 219 Delete Tracking Results by Specifying the Range

5.2.7 Method to Track Again

Figure 220 is a reference screen when Point 1 has been partially deleted.

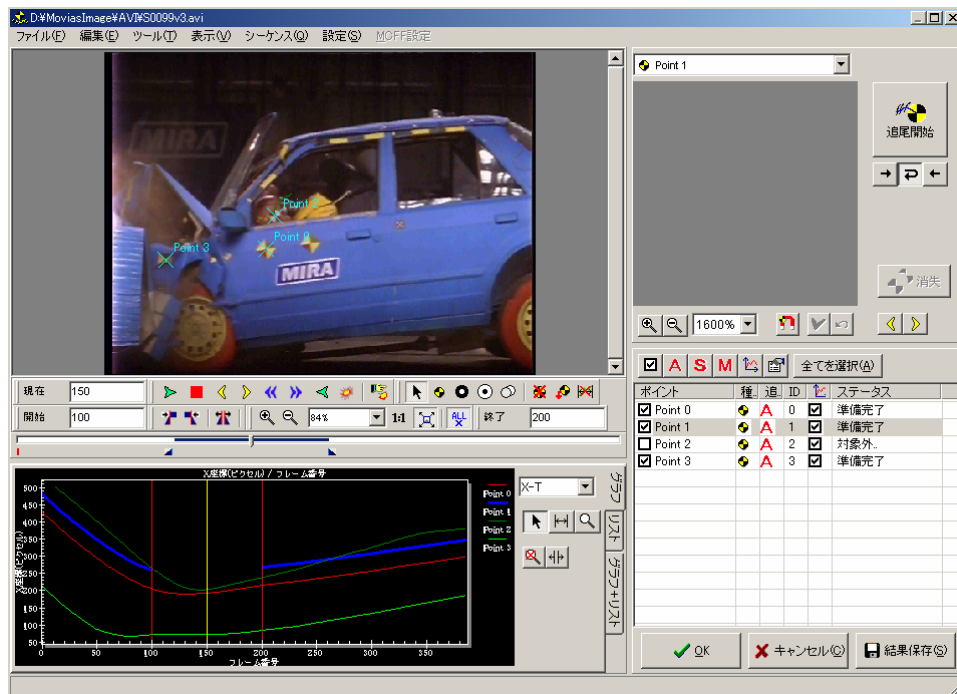


Figure 220 Partially Deleted Point 1

In this example, Point 1 in the range of frames 100~200 is partially deleted. The current frame is 150.

To begin retracking Point 1, click the “Start Tracking” button.

The dialogue box in Figure 221 will be displayed to specify the location of Point 1.

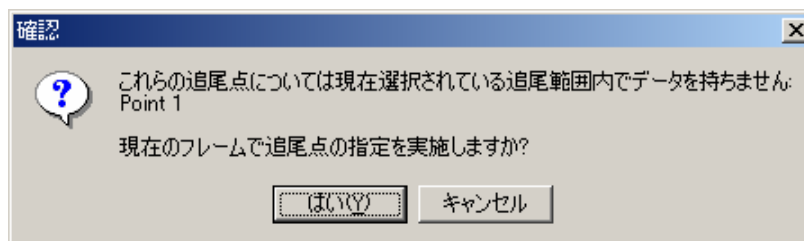


Figure 221 Dialogue Box to Specify the Location of Point 1

Click “Yes”. The screen in Figure 222 will be displayed to reset the location of Point 1.

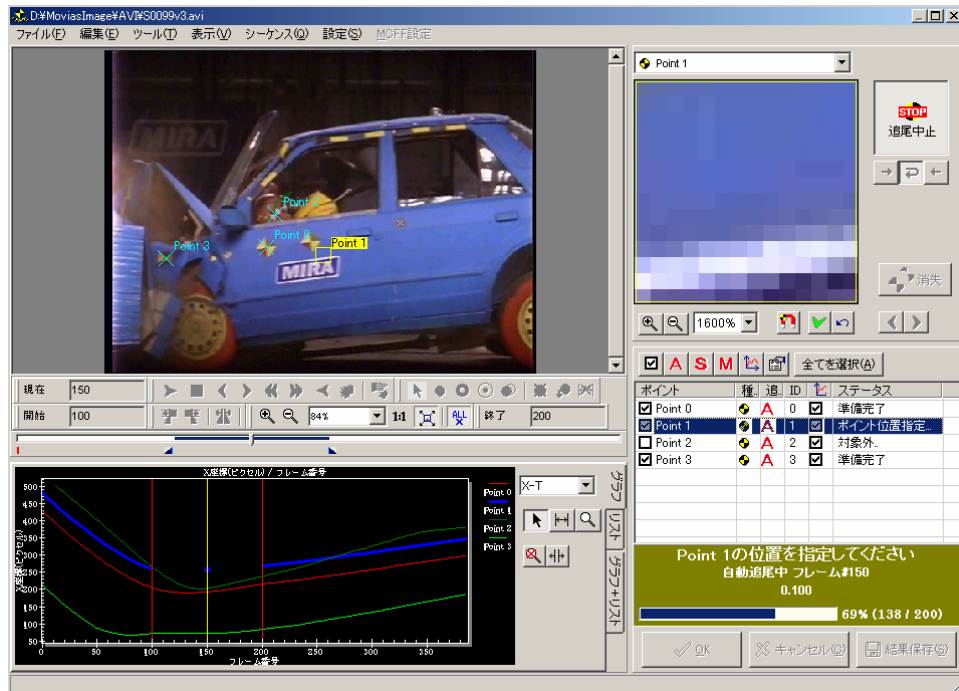



Figure 222 Resetting the Location of Point 1

After Point 1 is displayed with a frame in Video View, drag this frame to the location of Point 1. An enlarged figure of the location dragged will be displayed in Zoom View so click on the exact center of the target and then click Verify .

Point 1 retracking will begin within the specified range.

5.2.8 Adding Targets

If adding points, such as when adding a 5th point (Point 4) to where tracking has already been completed on four points, this is identical to that found in 2Motion Analysis Tutorial エラー! 参照元が見つかりません. . If the 5th point is a 4-quarter target, first click on the Add 4-quarter Target button (Figure 223) to access the Add 4-quarter Target mode.



Figure 223 Add 4-quarter Target Button

Next, click in the vicinity of the center of the 5th point in Video View. (Figure 224)



Figure 224 Click on the Center of Point 4

The results are shown in Zoom View. (Figure 225)

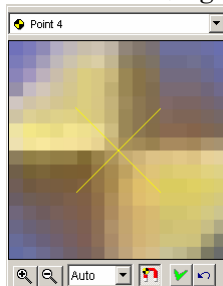



Figure 225 Point 4 Detection Results

When displayed in Zoom View, detection of the center position is automatically conducted. If there are no problems with the detection results, click Verify . If there is a problem with the detection results, correct and then click Verify. Then click “Start Tracking”.

5.2.9 Changing Tracking Parameters

It is necessary to set appropriate values for various parameters to automatically track targets. To set parameters, first select the tracking points and then select the “Edit – Properties” menu (Figure 226), right click on the tracking points in the tracking point list to select the Properties menu (Figure 227), click the “Properties Button” (Figure 228) or double click on the tracking points list.

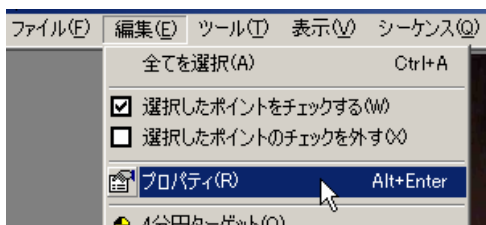


Figure 226 Edit – Properties

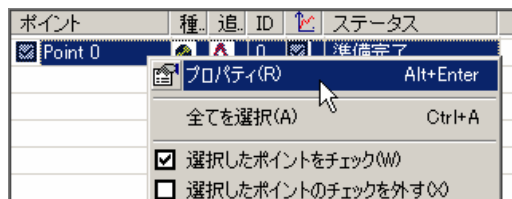


Figure 227 Properties Menu

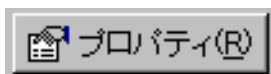


Figure 228 Properties Button

The tracking point properties screen in Figure 229 will open.

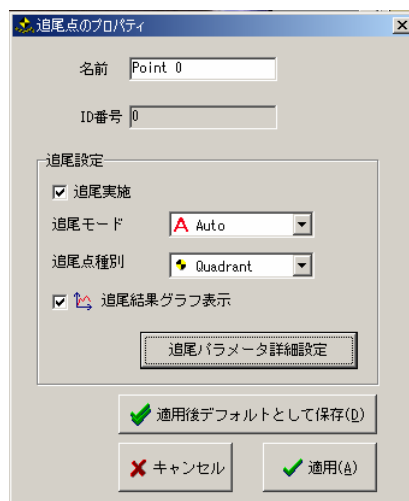


Figure 229 Tracking Point Properties

Click on “Detailed Settings for Tracking Parameters” on the tracking point properties screen. Depending on the type of tracking point, the detailed settings for tracking parameters will open, as shown in Figure 230, Figure 231 or Figure 232. Refer to “3.3.2 Tracking Parameters” or “3.3.3 Method of Setting Tracking Parameters” to set the parameters.

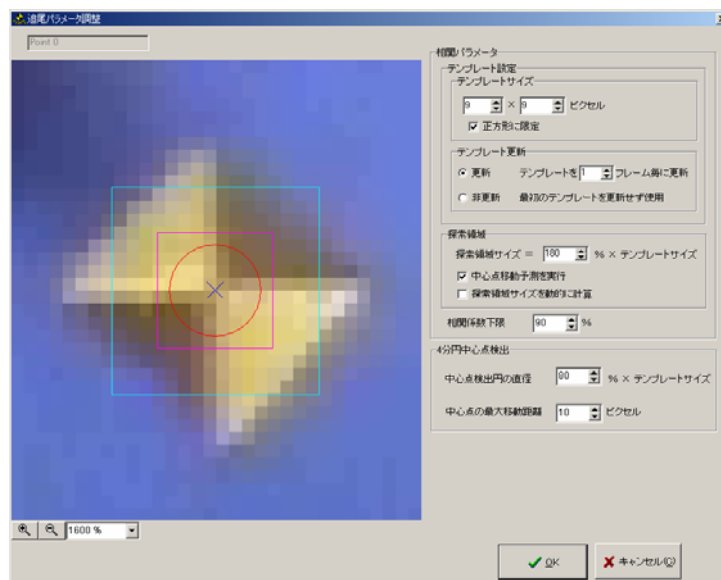


Figure 230 Detailed Settings for Tracking Parameters for 4-quarter Marks

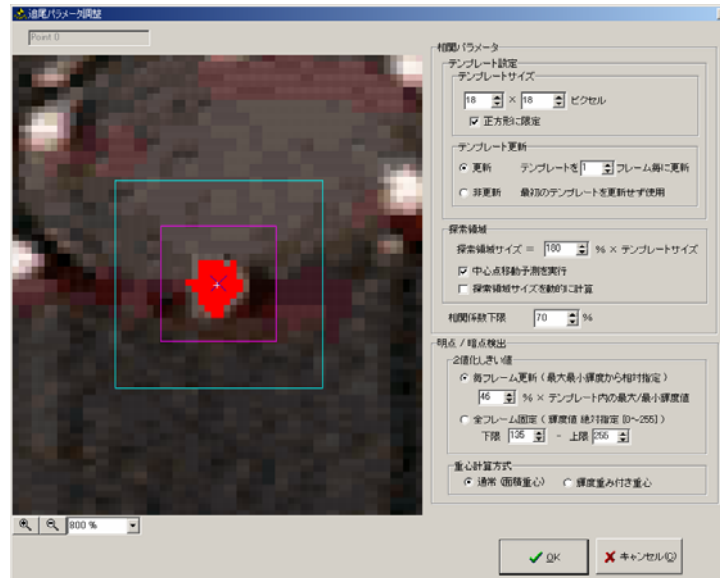


Figure 231 Detailed Settings for Tracking Parameters for Solid/Shaded Marks

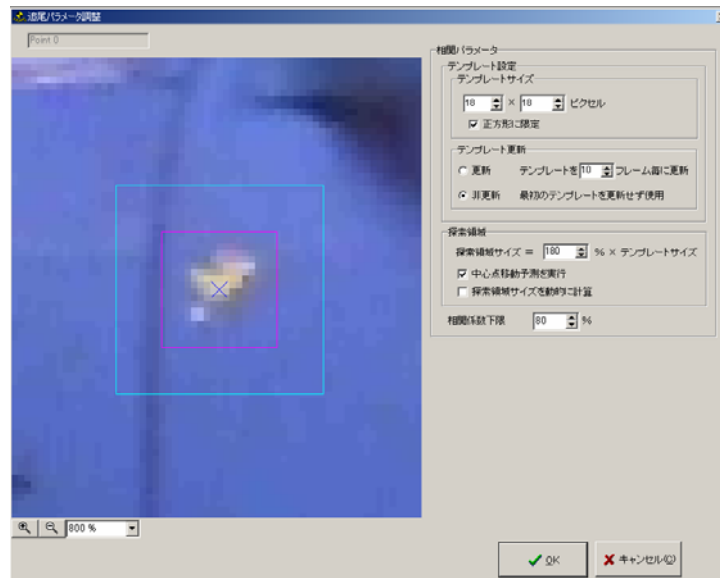



Figure 232 Detailed Settings for Tracking Parameters for Correlation Marks

After setting the parameters, click “OK” to close the screen. It will return to Figure 229 Tracking Point Properties.

Click “Apply” to apply the specific tracking parameter settings to the tracking points. Click “Save as Default after Applying” and then click “Apply” to apply the tracking parameters to the tracking points and make the current settings the default settings.

5.2.10 Correcting Tracking Results

The procedure for correcting tracking that extends across sections is as described in エラー! 参照元が見つかりません。 エラー! 参照元が見つかりません。 . The procedure for correcting tracking results from a single frame to multiple frames is as follows.

Figure 233 shows an example where a problem with tracking causes distorted results for center detection. If this type of distortion occurs, use the mouse to click on the true center in Zoom View or drag the mouse to the true center based on the detection results using the ✕ mark. Then, click Verify .

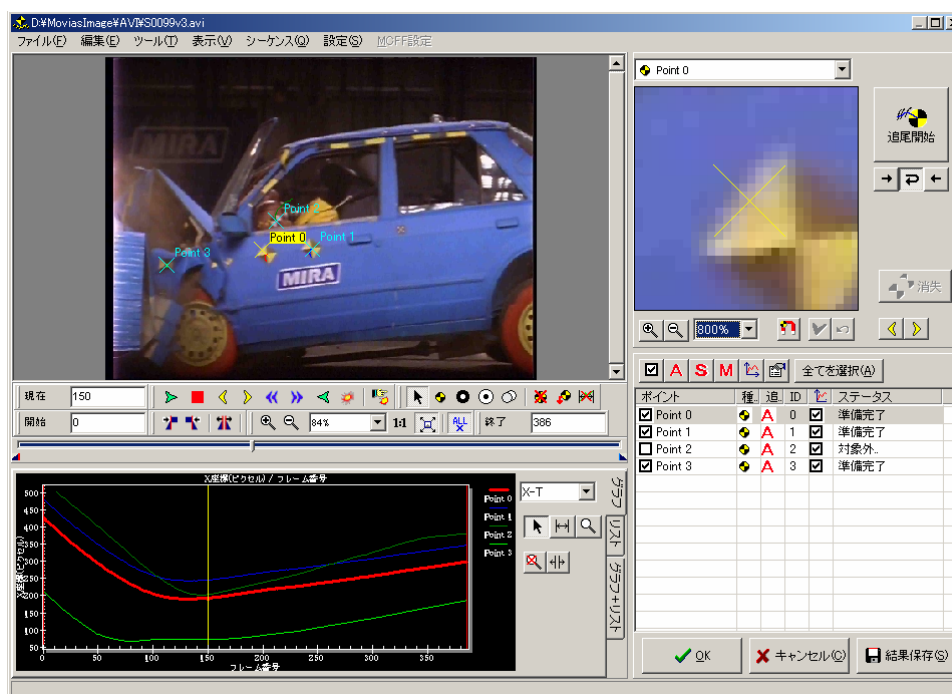


Figure 233 Screen to Correct Tracking Results

6. About Movias Pro Viewer

Movias Pro Viewer opens projects created in Movias Pro and is designed to display the analytical results, including graphs and video display of sequences previously created.

Since it is designed specifically for displaying, it cannot track newly created sequences or create new graphs.

It can be operated without the HASP security key. Results analyzed in Movias Pro can be displayed on other PCs.

Features and notes for Movias Pro Viewer are as follows.

- Movias Pro Viewer can be used to present the data analyzed by Movias Pro on separate PCs and to distribute to other researchers.²⁵
Since the HASP security key is not needed, any PC meeting the requirements in 1.2 Recommended Operating Environment can display the results of analysis with Movias Pro.
- The folders for projects created in Movias Pro can be copied if displaying or distributing Movias Pro analysis results on other PCs.(3.21) Project Folder Structure and Backup → page 44)
- When using Movias Pro Viewer and creating new sequences with Movias Pro, AVI files are copied into the projects.
- Movias Pro Viewer can only display results previously created in projects. New sequences cannot be created or tracked, nor data edited.
- Graphs can display results entered. New graphs cannot be created.
- Settings for the starting point, coordinate axis and 2D calibration can be verified but not changed.
- Operation is identical to that of Movias Pro.

²⁵ Movias Pro Viewer can be distributed as desired. Please do not distribute on internet web sites or ftp sites without permission from this company. Distributing on the local network or emailing to specific addresses is allowed.

7. About LAA Measurement

LAA measurement is software included with Movias Pro that easily measures the length, area and angle of the subject in an image file. It is also possible to determine the velocity, amount of motion and rotation speed using video image files.

7.1 Opening the Startup and Image Files

Click “LAA” in “Start—Programs—NAC Applications” to start. Once started, the opening screen in Figure 234 will be displayed.

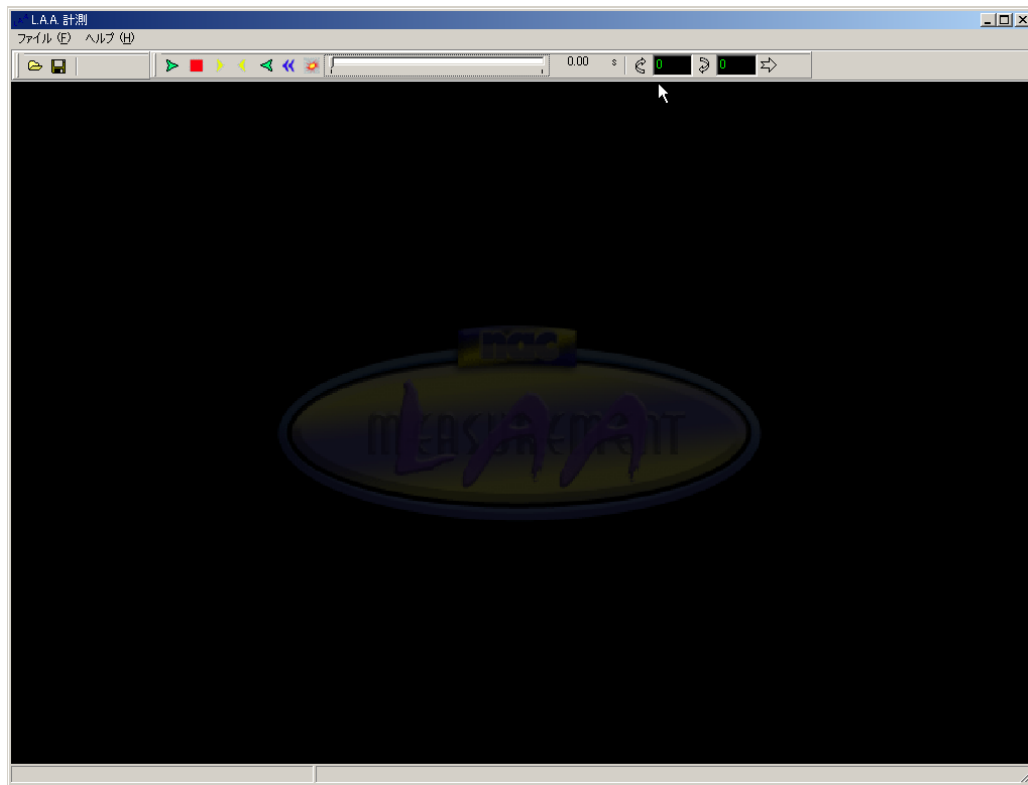


Figure 234 LAA Measurement Opening Screen

Open the image file to be measured in the “File—Open” menu. Usable image files include AVI files, nac MCFF files, TIFF files, JPEG files and BMP files. Once the image file is open, the screen in Figure 235 will be displayed.



Figure 235 LAA Measurement Open Image File

- **Start Measurement Button** Click this button to open the measurement section on the left side of the screen.
The three tabs in the measurement section include measurement, image settings and MCFF settings. (See エラー! 参照元が見つかりません。 for details.)
- **Text File Output Button** Click to output the remaining measurement results to a text file. (See 7.3 for details)
- **Frame Number** Displays the frame number.
- **Time data** Displays the time data converted from the frame number using the photographic speed information.

7.2 Measurement Section

7.2.1 Measurement Tabs

Click on the Start Measurement Button in Figure 235 to open the measurement tab screen in Figure 236.

Size conversion settings, length measurement, area measurement and angle measurement can be performed using the measurement tab.

If there is a need to set photographic speed information such as when the time difference between frames must be measured, set the photographic speed information and To frame information using 7.2.2Image Settings Tab before using this measurement tab.



Figure 236 Measurement Tab

1) Size Conversion Settings

Size conversion settings that become the basis for length and area measurement are set with the Size Conversion Settings section shown in Figure 237.



Figure 237 Size Conversion Settings Section

First, click “Specify Standard Points” and then sequentially click on two points in the image with known intervals. Next, click “Specify Standard Length”, set the interval and unit and then click “OK”. (Figure 238)

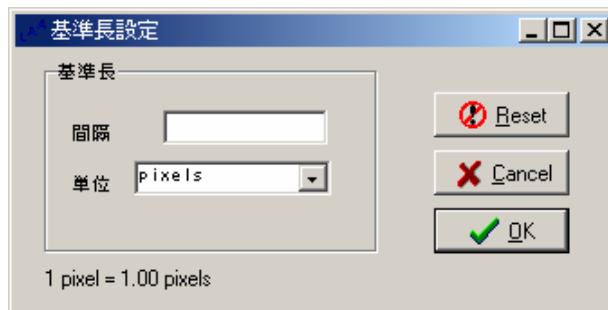


Figure 238 Standard Length Interval and Unit Settings

If not setting a standard length,

- The length and area can be obtained from the result of pixels.
- Angles can be obtained from standard results.

2) Measurement of Length and Area

Since the measurement of length and area are identical, a combined explanation is given.

Measurement of length and area is conducted in the section shown in Figure 239.

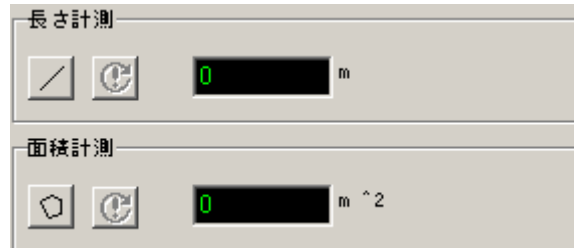




Figure 239 Measurement of Length and Area

Under the Start Measurement button, click on  for length or  for area.

Next, sequentially click on the section for length or area.


Click on at least 2 points for length and 3 points for area. Each time a point is clicked greater than the required number of points, the measurement results will be displayed.


Click  to jump to measure the length or area of another section.


Once measurement is complete, click  again or click .

3) Angle Measurement

Angle measurement is conducted in the section shown in Figure 240. The two methods include the angle measurement method of specifying 3 points and the method of specifying 4 points.

Click  to measure by specifying 3 points. Then, proceed according to 3-1) Angle Measurement Specifying 3 Points .

Click  to measure by specifying 4 points. Then, proceed according to 3-2) Angle Measurement Specifying 4 Points .

Click  to measure by specifying 4 points. Then, proceed according to 3-2) Angle Measurement Specifying 4 Points .

On the right side of Figure 240, check degrees or radians to select the unit for the measurement results.

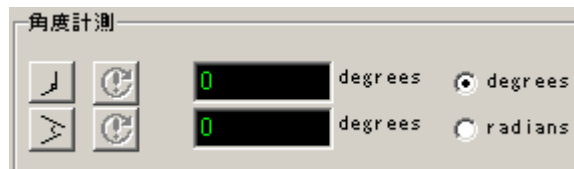


Figure 240 Angle Measurement

3-1) Angle Measurement Specifying 3 Points

As shown in Figure 241, for angle measurement specifying 3 points, first click on the location of the starting point for the angle, which will be the first point. Next, click on the 2nd and 3rd points forming the angle. Angle measurement is conducted counterclockwise using the line connecting the 1st and 2nd points as the standard.

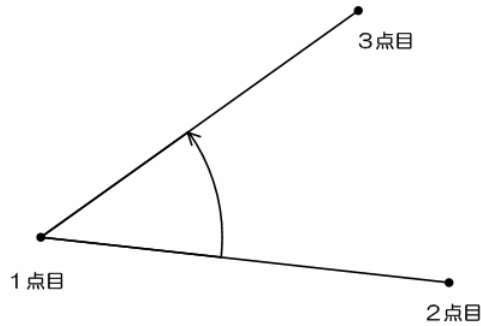


Figure 241 Angle Measurement Specifying 3 Points

3-2) Angle Measurement Specifying 4 Points

As indicated, angle measurement specifying 4 points first determines the line to be standard between the 1st and 2nd points. Next, determine the 2nd line between the 3rd and 4th points. Angle measurement is determined counterclockwise from the standard line to the 2nd line.

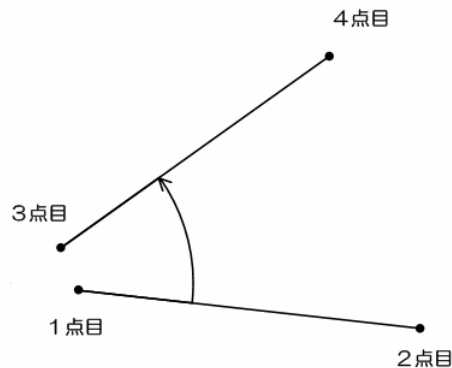


Figure 242 Angle Measurement Specifying 4 Points

4) Specifying Location with an Enlarged Image

A precise location can be specified using an enlarged image to specify standard length or to measure length/area/angle.



Figure 243 Specifying Location with an Enlarged Image


To specify a location using an enlarged image, check “Use Enlarged Image” in Figure 243. Then, click on the location in the image to specify in the same manner as usual. The area around the clicked location will be enlarged. Click on the location of the enlarged image to specify.

7.2.2 Image Settings Tab

Click on the image settings tab to open the screen shown in Figure 244. This screen is used for playback speed, photographic speed and To frame settings for video image files.



Figure 244 Image Settings Tab

- **Playback speed** Sets the playback speed for playback of the video image file. The playback speed depends on the PC performance so the value set is the standard. Check Playback Speed Preference to jump frames when the playback speed is less than the set value so it is as close to the set value as possible.
- **Image Information FPS** Sets the photographic speed when photographing video images.
- **T0 Frame** Click  after the frame to be the starting point of time measurement, such as the instant of impact, is displayed so that frame will become the time standard frame.

7.2.3 MCFF Settings Tab

Click the MCFF settings tab to open the screen in Figure 245. Adjustments such as Gain or Gamma are made in this screen when the MCFF file that is the video image file is opened.

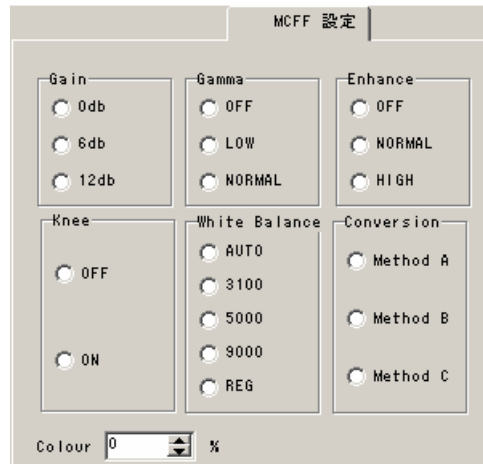


Figure 245 MCFF Settings Tab

7.3 Text File Output


After opening an image file, click  on the tools menu to specify the location to save the file and the file name, and subsequent measurement results can be saved as text files.



Figure 246 Tools Menu

Text file output is conducted automatically, and output continues until the LAA measurement program is finished.

7.4 Practical Examples

Several practical examples using video images are given here. These are provided to explain the procedure and have no numerical significance.

7.4.1 Amount of Motion and Velocity

Using a video image photographing the location where an automobile reaches a given speed, the amount of motion and velocity can be determined. Figure 247 shows the screen where the 1st point for length measurement has been clicked after the photographic speed and size conversion settings have been made. The time is 0.02 seconds.

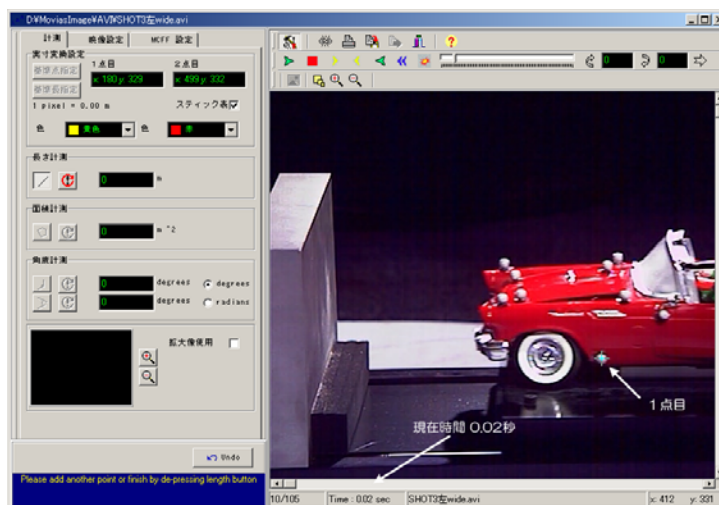


Figure 247 Length Measurement 1st Point

Figure 248 shows the screen where the 2nd point was clicked 15 frames later. The time is 0.05 seconds with a length measurement of 0.0668m. The amount of motion is 0.0668m during 0.03 seconds, so the speed of motion per second is approximately 2.2m.

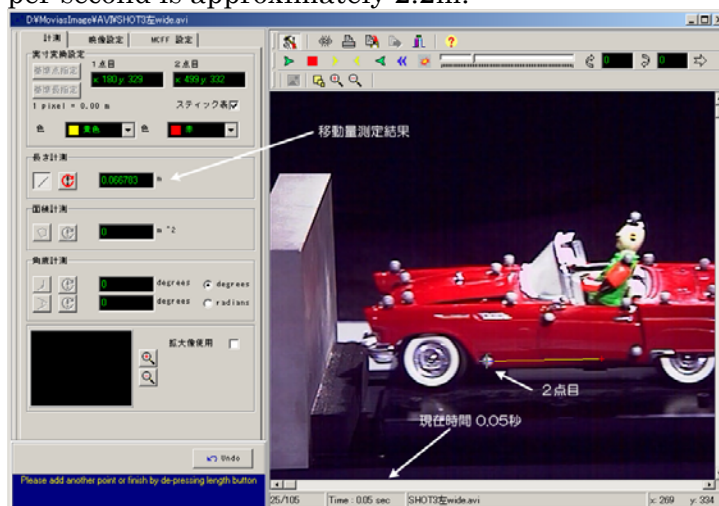


Figure 248 Length Measurement 2nd Point

7.4.2 Rotation Angle and Angle Speed

Using a video image photographing the location where there is rotation at a given speed, the rotation angle and angle speed can be determined.

Figure 249 shows the screen where the 1st and 2nd points for angle measurement have been clicked after the photographic speed settings have been made. This time is 0.0 seconds

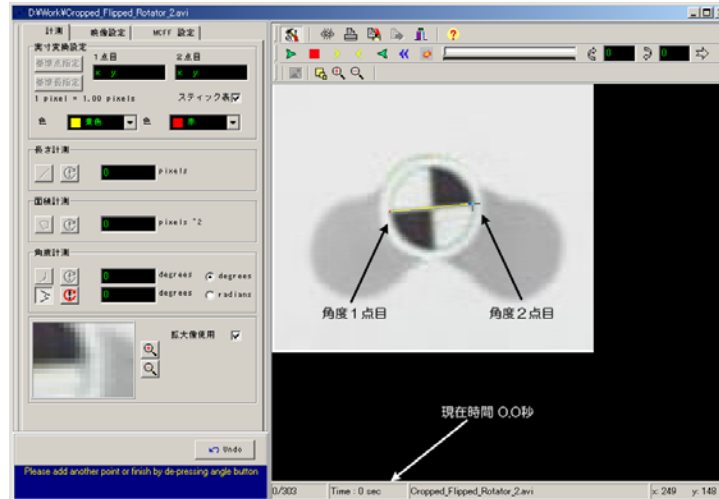


Figure 249 Angle Measurement 1st, 2nd Points

Figure 250 shows the screen where the 3rd and 4th points were clicked 20 frames later.

The time is 0.02 seconds with an angle measurement of 30.5°.

The amount of rotation is 30.5° during 0.02 seconds, so the speed of rotation per second is approximately 4.2 rotations.

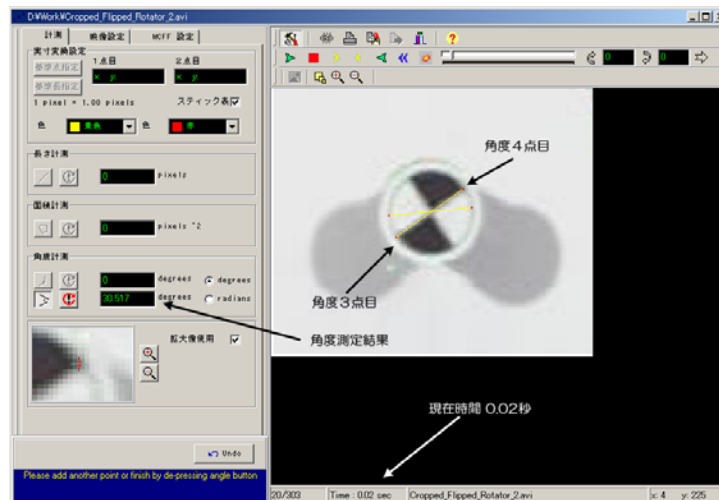


Figure 250 Angle Measurement 3rd, 4th Points

7.5 Note

As indicated, velocity and rotation speed are easily determined with LAA measurement. However, this does not apply to velocity and rotation speed with gradual changes over time. Use Movias Pro for this.

8. About Image Converter

Image Converter is a program to convert the format for image files. Multiple TIFF and BMP files are converted to AVI files with sequentially numbered file names and AVI files are converted to sequential TIFF and BMP files.

8.1 Startup

Click “Movias Tool – Image Converter” in “Start—Programs—Movias Pro ***” (***) refers to the version number) to start.

8.2 Specifying File to be Converted

Select “Open Local” in the file menu. First, select the type of file to be converted in the file type section. (Figure 251)

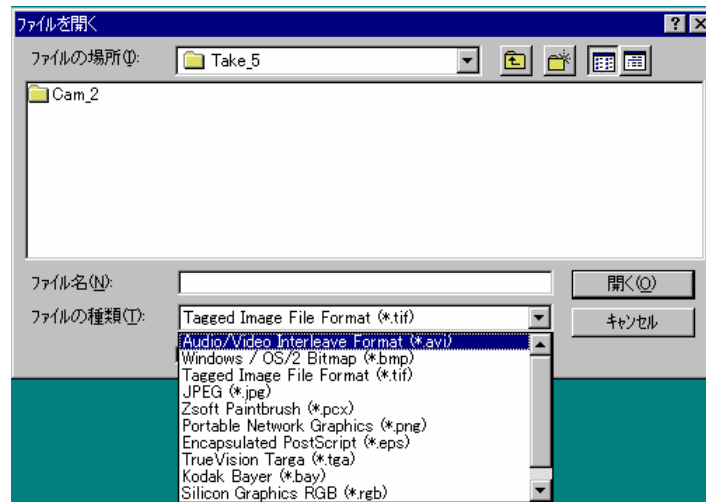


Figure 251 Specify File to be Converted (1)

Next, move to the folder where the file to be converted is saved. A list of files to convert will be displayed on the screen. (Figure 252)

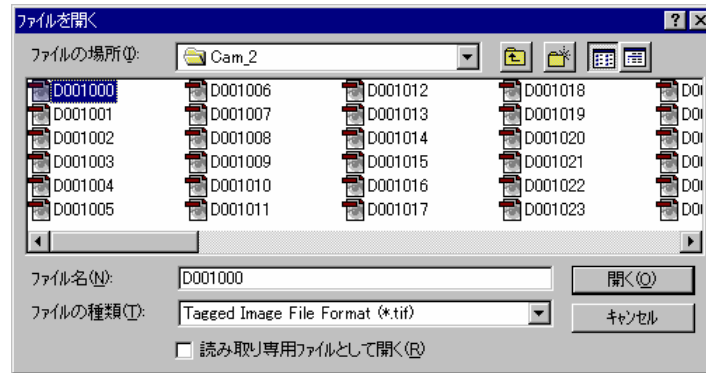



Figure 252 Specify File to be Converted (2)

Click on the file to be converted from this list of files and press “Open”.

If there are multiple sequential files to be converted, select the file with the lowest number. (Refer to 8.7)


If it is difficult to locate the file with the lowest number, press  at the top right of the screen and double click on **名前** to switch the files to numerical order.

8.3 Verify Image

After specifying the file for conversion in the previous section, the screen shown in Figure 253 will be displayed. Playback this image as a video and confirm whether or not it was specified correctly.



Figure 253 Verify Image for Conversion

There are playback control buttons () above the image. Use these to verify the image. The functions of the buttons are as follows.



: Forward or reverse playback



: Pause playback



: Stop playback and return to the first frame



: Frame by frame playback or reverse



: Specify the interval for playback for play or frame by frame playback

For example, playback of every other frame when 2 is specified.



: Return the changes in display size of the dragged area in the window to the original.



: These buttons have no function.)

8.4 Conversion Settings

Select “Save As...” from the file menu. The screen for settings (Figure 254) will be displayed.

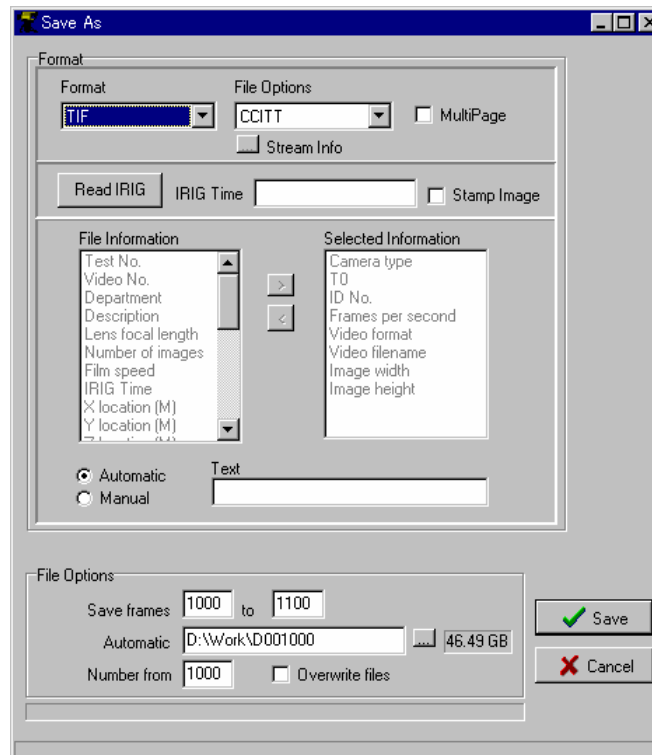


Figure 254 Save As Screen

The operations are as follows.

1) Format Section Specify Conversion File Format

Specify the conversion file format in the section shown in Figure 255.

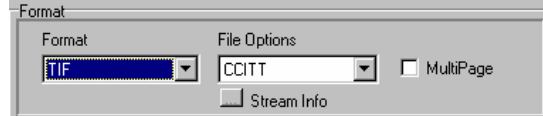


Figure 255 Specify Conversion File Format

Specify the BMP, TIFF or AVI file format in the Format section.

Designate the options for each format in the File Options section. Options are as follows.

1-1) BMP Files

There are no options for BMP files.

1-2) TIFF Files

Select None of the several options for TIFF files.

1-3) AVI Files

Select either Compress or Uncompressed for AVI files. If selecting Compress, specify the compression format with the steps to create AVI files. (refer to 8.6)

There are no special operations required in the Format section shown in Figure 256. The screen should remain unchanged.

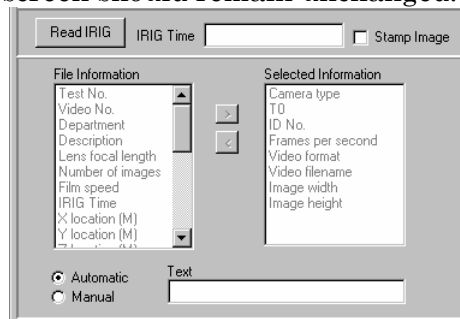


Figure 256 (no special operation required)

2) File Options Section Specify Conversion File Name

Specify the conversion file name in the section shown in Figure 257.

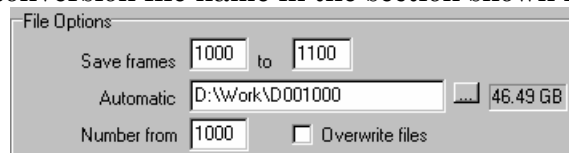


Figure 257 Specify Conversion File Name

2-1) Save frames Section

The range of frames to be converted is set by specifying the minimum value and maximum value for the frame number.

The defaults displayed are the maximum and minimum values for the conversion file. At this point, if the conversion file is a BMP or a TIFF file, the minimum and maximum values will be displayed. If the conversion file is an AVI file, the minimum value will be 0 and the maximum value will be the number of frames in the AVI file. (in reality, one less than the frame number)

If all of the frames in the conversion file are to be converted, there is no need to change these figures. If changing the range of frames to be converted, specify both the number of the frame to begin conversion and the number of the frame to end conversion.

2-2) Automatic Section

Specify the location and file name for the conversion file (the converted results) to be saved. If selecting a BMP or a TIFF file as the format for the conversion file, it will be added to the file name specified.

2-3) Number from Section

Specify the beginning number.

8.5 Conversion

Click “Save” at the bottom right of the screen in Figure 254. This starts conversion. Once conversion is complete, “All Done” will be displayed at the bottom left of the screen. (Figure 258)

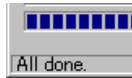


Figure 258 Completing Conversion

8.6 Specifying the Compression Method

If Compress has been specified for the AVI file to be converted in 8.4 Conversion Settings, after clicking “Save”, the following compression settings screen will be displayed.

(Figure 259)

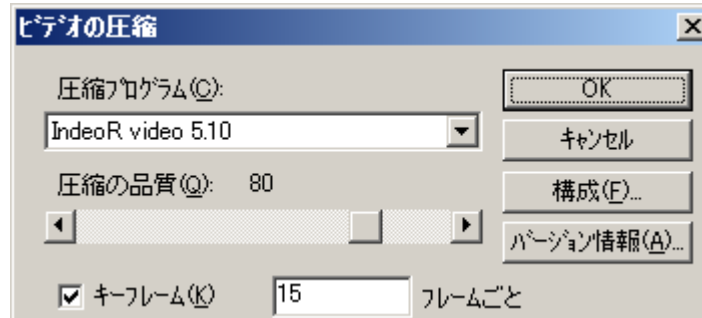


Figure 259 Specifying the Compression Method

1-1) Compression Program Section

This specifies the compression program (Codec) used for compression. Use Codec installed on the PC. An example of Codec is IndeoR 5.10.

1-2) Compression Quality Section

Set the compression quality.

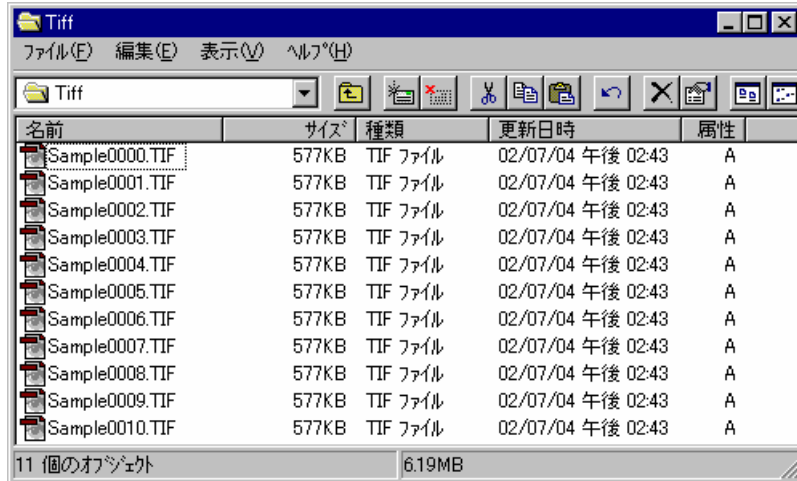
The larger the number, the higher the quality but the size of the file will also increase.

1-3) Key Frame Section

Input the key frame interval. If the number is too large or too small, there will be problems such as excessive time required when jumping frames so input a number from 10~30.

8.7 About Consecutive File Names

Figure 260 shows an example of an AVI file called Sample.avi converted to a TIFF file with the starting number of 0. Consecutive numbers starting with the starting number can be added to the conversion file names.

**Figure 260 Consecutive File Names**

On the other hand, if multiple copies of BMP or TIFF files are converted to AVI files, assign consecutive file names to the BMP or TIFF files in advance, as shown in Figure 260.